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ABSTRACT

Economists regard information and feedback as important ways for self-correction in a system. This study analyses one aspect of information and feedback in the South African education system.

Continuous assessment (CASS) carries a 25% weight in the final matriculation (Grade 12) mark and, more importantly, provides feedback on performance that affects examination preparation and effort. Weak assessment in schools means that pupils are getting wrong signals that may have important consequences for the way they approach the final examination. Moreover, similarly wrong signals earlier in their school careers may also have affected their subject choice and career planning.

This study analyses data on CASS and compares it to the externally assessed matric exam marks for three years for a number of subjects. There are two signalling dimensions to inaccurate assessments: (i) Inflated CASS marks give students a false sense of security that they are well-prepared for the matric exams, thereby leading to unrealistic expectations and diminished effort. (ii) A weak correlation between CASS and the exam marks means poor signalling in another dimension: Relatively good students may get relatively low CASS marks. This indicates poor reliability of assessment, as the examination and continuous assessment should both be testing the same mastery of the national curriculum. The paper analyses the extent of each of these two dimensions of weak signalling in South African schools, by subject, province, socio-economic background of schools, and public versus independent schools. The analysis draws disturbing conclusions for a large part of the school system.

Keywords: Economics of Education, assessment, asymmetric information, South Africa
JEL: I21, D82

[1] *This paper is based on a report to Umalusi (Van der Berg & Shepherd 2009). Earlier version were presented to Umalusi in October 2007 and to the 5th Conference of the Association of Commonwealth Examinations and Accreditation Bodies on "Improving the Quality of Public Education in the Commonwealth", Pretoria, 9-14 March 2008. The authors wish to thank Tim Dunne and Emmanuel Sibanda for advice on the quantitative methodologies used, Derek Yu for assistance with analysis of the data, and various members of Umalusi's Research Committee for useful comments.*

To be technically sound, assessments must be both valid and reliable. An assessment is valid when it is used for the purposes for which it is designed, allowing appropriate interpretations of the results. A reliable assessment provides test scores that consistently measure a student's knowledge of what is being tested. Assessments used in standards-based systems should meet a third criteria (sic), alignment, or the degree to which the assessment adequately reflects the standards on which it is based. (Pearson Education, no date; emphasis added)

1. Introduction

Continuous assessment (CASS) is an important part of the evaluation of South African students at matriculation level, with a 25% weight in the final matriculation mark. Matriculation results determine options for university entry, bursaries, career choice, and labour market prospects. As CASS gives feedback to students on their performance during the matric year, it is likely to influence their examination preparation and effort.

Economists place great stock in information as signalling device. For a student, whose objective is to get through the assessment tasks successfully (Nicol and Macfarlane-Dick, 2006), feedback from continuous assessment ought to provide them with signals about how well they have mastered the material. Unintended consequences arise when the information from continuous assessment does not correspond with the desired learning outcomes. Thus, for instance, CASS tasks, set by the teacher at school level, may not support the outcomes set by the national curriculum standards. Weak assessment gives students wrong signals that could influence their learning strategies, their examination effort and their future planning. Moreover, if weak assessment quality is common in matric, it is likely to be even more common in lower grades. Thus it may also already have exerted an influence on subject choice, career planning and even the decision to persevere to matric rather than pursuing alternative options, such as electing to pursue vocational training.

This study, initially undertaken for Umalusi, evaluates the quality of school-based CASS compared to the externally moderated matriculation examination (which for present purposes will be regarded as the "correct" assessment of student performance[2]), using data for a number of subjects for 2005 as well as the two previous years. Alternative measures of assessment accuracy are used to determine to what extent CASS marks give poor signals to students as to their likely matriculation performance.

Such an analysis illuminates two important questions. The first relates to the subject knowledge of teachers. Teachers with poor subject knowledge are likely to give assess less accurately. Thus such an analysis could help to identify teachers who do not teach to the curriculum standard, whether due to poor subject knowledge or other reasons. It is possible to determine where such teachers are located (e.g. in what province, district or school) and in which subjects this problem is particularly severe. Secondly, assessment marks act as information to matriculants about how to prepare for the examination: It informs them how well they are prepared and thus what confidence they can have about succeeding in different subjects, and where their weaknesses are, thus allowing them to prepare better for the matriculation examination. Thus, a low signal to noise ratio in assessment (i.e. high inaccuracy) gives students less information on how to prepare, contributing to weak examination results.[3]

[2] *This ignores the possibility of inconsistent examinations marks or that the examination marks may be endogenous, determined in part by behaviour responding to the assessment mark. Even with full correspondence in levels of difficulty between the CASS and examinations, one would expect a less than perfect correlations between marks. Firstly, it is likely that students put in enhanced effort in the final matriculation, particularly if they performed weakly in the CASS. This should serve to reduce or even reverse the gap actually observed, i.e. higher CASS than exam marks. Secondly, there is variation in performance even when the test difficulty and preparation remain unchanged.*

[3] *In unpublished work, Leibbrandt and Lam (2006) have suggested another interesting hypothesis: In earlier grades, weak assessment of examinations makes it more attractive for weak candidates to continue in school, whereas better candidates have a higher probability of failing than they should have, which would make them less sure to persevere.*

The paper proceeds as follows: Section 2 shows how assessment act as signalling and how signalling can be measured; Section 3 details the data and especially the methodology followed; Section 4 compares marks nationally: Section 5 deals with assessment accuracy at the school level; and Section 6 concludes the paper and offers some policy suggestions.

2. Assessment as signalling: How to measure it

CASS marks are determined at the school level, based on tasks that are not standardised across schools but vary by teacher in terms of number, level of difficulty and marking accuracy. Thus such marks are less accurate than the externally set, marked and moderated matric exams. It is therefore fair to use the exam mark as the standard against which to judge CASS marks.

This study distinguishes two types of assessment inaccuracies, in terms of their statistical qualities, with different signalling dimensions:

- **Assessment leniency (where CASS marks are much higher than exam marks):** An inflated CASS mark, where it is much higher than examination marks, can give students a false sense of security about how well they are prepared for the exams in that subject. This could elicit inappropriate studying behaviour (e.g. diminished effort in that subject), thereby further weakening examination results. A few teachers purposely limit CASS marks, to encourage candidates to work harder for the examination. But only in about 12.2% of cases in the subjects selected for this analysis did examination marks exceed CASS marks, an indication that this was not a very widespread practice. The rising weight attached to CASS marks in the final mark also mitigates against such a strategy. Thus teachers should ideally aim to minimise the difference between the CASS mark and the examination mark. But even if this difference is small or even zero for an individual class or school, the information content of the CASS mark could still be weak, if the second measure (correlation) is poor.
- **Low assessment reliability (where performance measured by CASS and examination marks is only weakly correlated):** A poor correlation between CASS and examination mark indicates that the former is also an unreliable indicator of the individual's *relative* ability compared to classmates in a particular subject. In such a case, a student who scores low in the CASS mark may score unexpectedly well in an exam, compared to others who obtained better CASS scores. The converse could also occur: *relatively* high CASS marks could lead to disappointment in the examination. In such cases of a weak correlation in a particular school and subject between the CASS and the exam mark, signalling to students is weak in another dimension: CASS marks do not act as a good predictor of examination marks even in relative terms.

Poor performance in the CASS in either or both of these two dimensions of assessment (gaps or correlations) will be referred to as "weak", "poor" or "inaccurate" assessment. Ideally, there should be small gaps and high correlations between the two types of assessment. The extent of each of these two dimensions of inaccurate signalling will be analysed by subject, province, socio-economic background of schools (school quintiles), and independent versus public schools.

Given the explicit standards and content set by the national curriculum, a fair degree of consistency in the assessments for each subject should be possible. In well-functioning schools, one would expect, in the terms of the opening quote of this paper, validity (tests being well designed to test curriculum knowledge), reliability (consistently measuring the student's knowledge) and alignment with the national standards.

Thus weak assessment may have devastating results even before matriculation. Poor subject knowledge and weak assessment are likely to be even more common at earlier levels, as matric teachers are usually more experienced and often better qualified than other teachers.

Moskal and Leydens (2002) see reliability as follows:

> *Reliability refers to the consistency of assessment scores. For example, on a reliable test, a student would expect to attain the same score regardless of when the student completed the assessment, when the response was scored, and who scored the response. On an unreliable examination, a student's score may vary based on factors that are not related to the purpose of the assessment.*

Elsewhere they also stated that *"When the cause of variation in performance and the resulting scores is unrelated to the purpose of the assessment, the scores are unreliable."* (Moskal & Leydens 2002). The North Central Regional Technology in Education Consortium (2002) glossary of education terms declared that reliability meant that *"The same person is likely to get approximately the same score across multiple test administrations."* This, however, does not distinguish adequately between two sources of score differences between assessments, viz. differences in the means (levels) and differences in the relative scores (correlation). The former is related to the alignment, *"the degree to which the assessment accurately reflects the standard being measured"* (Burger, no date), and should thus ideally be distinguished from assessment reliability. It is useful to therefore consider another discussion of this concept:

> *Equivalent forms reliability examines the extent to which scores acquired from the same population on two different versions of an assessment are comparable. If different items (*or test – the authors*) truly measure the same concept, then it would be expected that the results of individual responses across these items would be highly correlated. (Moskal, Leydens & Pavelich 2002)*

Alignment in the standards of the examination and the CASS should ensure minimal gaps between these marks. However, in addition, the strong correlation referred to above is also sought, implying that the two types of assessment *"truly measure the same concept"*, i.e. knowledge of the curriculum.

Some examples taken from the 2005 Biology Higher Grade (HG) of the use of the different measures may be pertinent (for ease of presentation, only cases with relatively small classes are shown). Each of Figures 1 to 5 reflects raw CASS mark and raw examination marks of individual students in a particular school in Biology Higher Grade (HG), to illustrate how CASS marks can send signals of varying clarity to students.

Figure 1 below shows a school where the correlation between the CASS and exam mark was only 0.40. The 18 candidates from this school all performed better in the CASS than in the examination, thus all observations are located to the right of the diagonal. If CASS marks were the same as examination marks, all observations would have been on the diagonal. But CASS marks exceeded exam marks considerably: The arrow shows that, for Candidate b, the CASS mark should have been 24 marks (percentage points) lower to have corresponded with his/her exam mark.

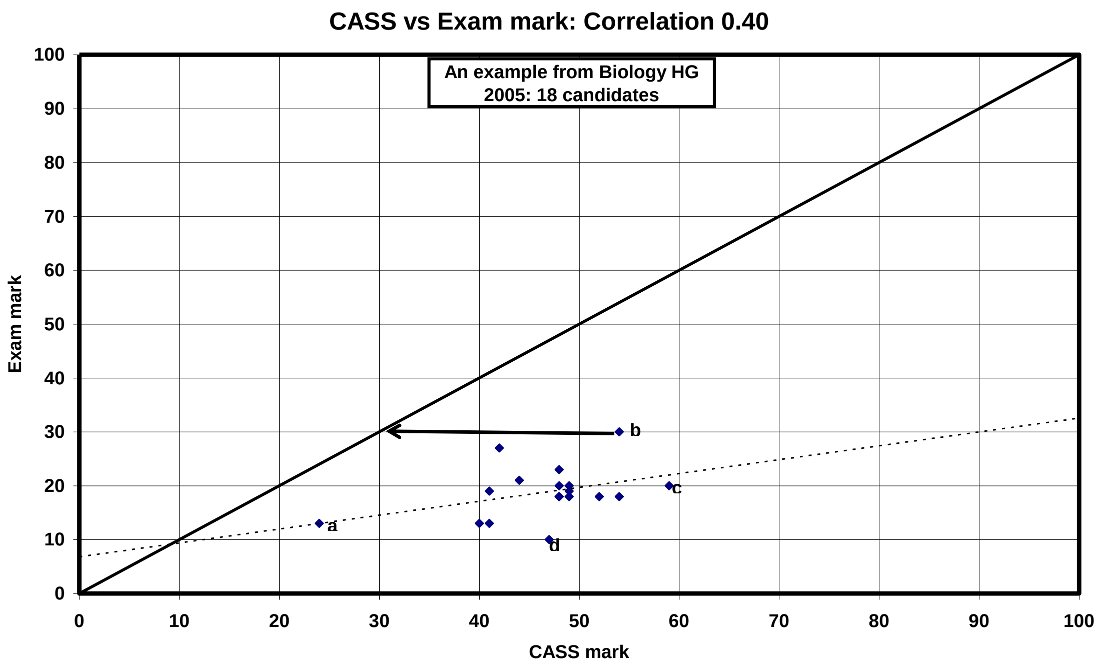
In this figure, there was much deviation around the dotted regression line: If all observations were on this line, or indeed on any other *upward* sloping line in this figure, it would have implied a perfect positive correlation (i.e. the correlation coefficient r would have been 1.00)[4]. On such a line, there would have been a perfect relationship between the CASS and examination marks, so that, *ex post*, one would have been able to predict exam marks perfectly from the CASS marks. But because candidates did not know how the CASS mark was likely to relate to the examination mark, *ex ante*, they would have had just the *magnitude* of the CASS mark as a measure of their performance. Candidate a would indeed have had the correct information, in terms of knowing that his/her prospects for passing Biology HG were very poor. But though all candidates except Candidate a achieved between 40% and 60% in the CASS, the best performer in the exam was Candidate b, who achieved only 30% despite a CASS mark of 54%. Candidate c, the best performer in the CASS with almost 60%, would have been completely misled, since his/her exam marks was only 20%.

[4] *If all observations were on a downward sloping line, the correlation would have been –1.0. a perfectly linear negative relationship. Essentially, the correlation measures how well data can be mapped from one variable onto another.*

Candidate d would also have been misled about relative performance, i.e. what mark to expect in the examination compared to his/her classmates.

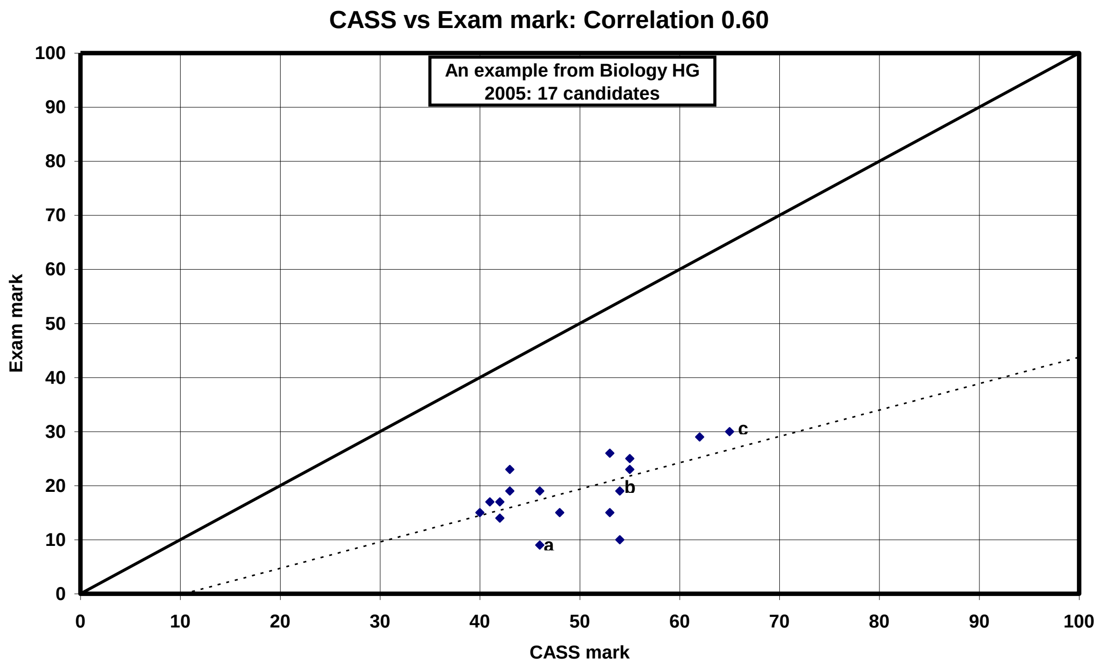
Therefore, the closeness of the observations around the regression line gives an indication of the correlation between CASS and exam marks, i.e. how well the relative ordering of CASS marks matches that of exam marks. In contrast, the deviation of observations from the diagonal indicates how inflated CASS marks are (the lower the observations lie below the diagonal, or the more to the right, the more inflated the CASS marks relative to exam marks).

Figure 1:



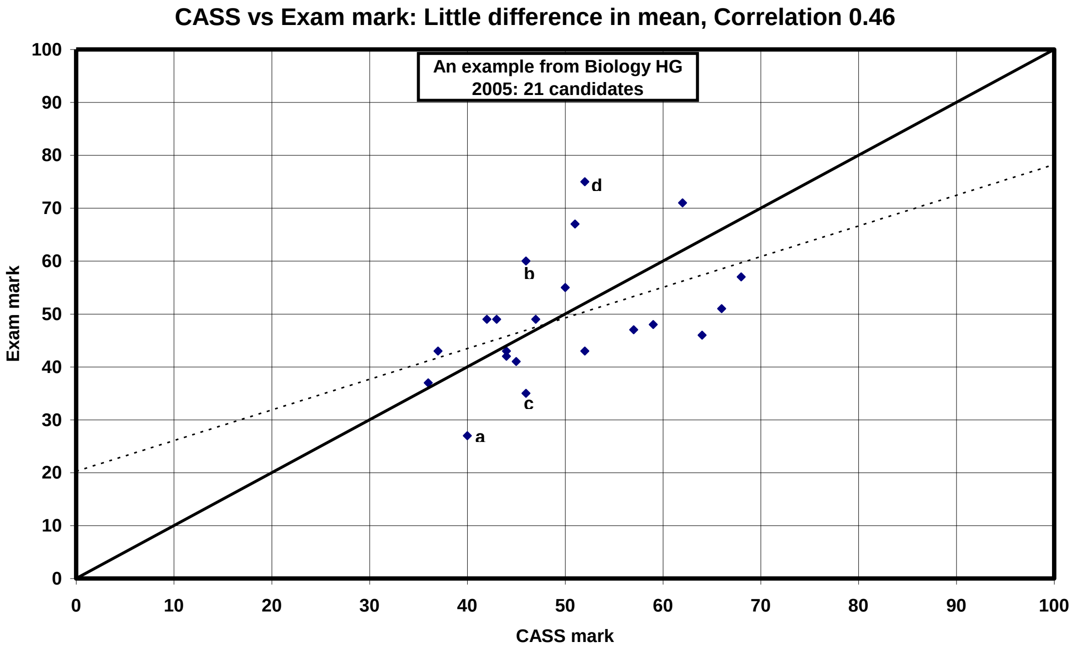
A better correlation between CASS and exam marks indicates that more reliable information is available to students about *relative* performance. In Figure 2 below, the correlation coefficient was somewhat better (r=0.60), as reflected in the observations being more tightly arranged around the regression line, with the result that these 17 candidates had a little better information about what to expect in the exam, in terms of their *relative* performance within the class. But here, as in the previous figure, the average gap between the CASS and examination marks was again a massive 28 percentage points. With such a large gap, the greater accuracy of relative performance levels still offered little useful information: All candidates failed the examination.

Figure 2:



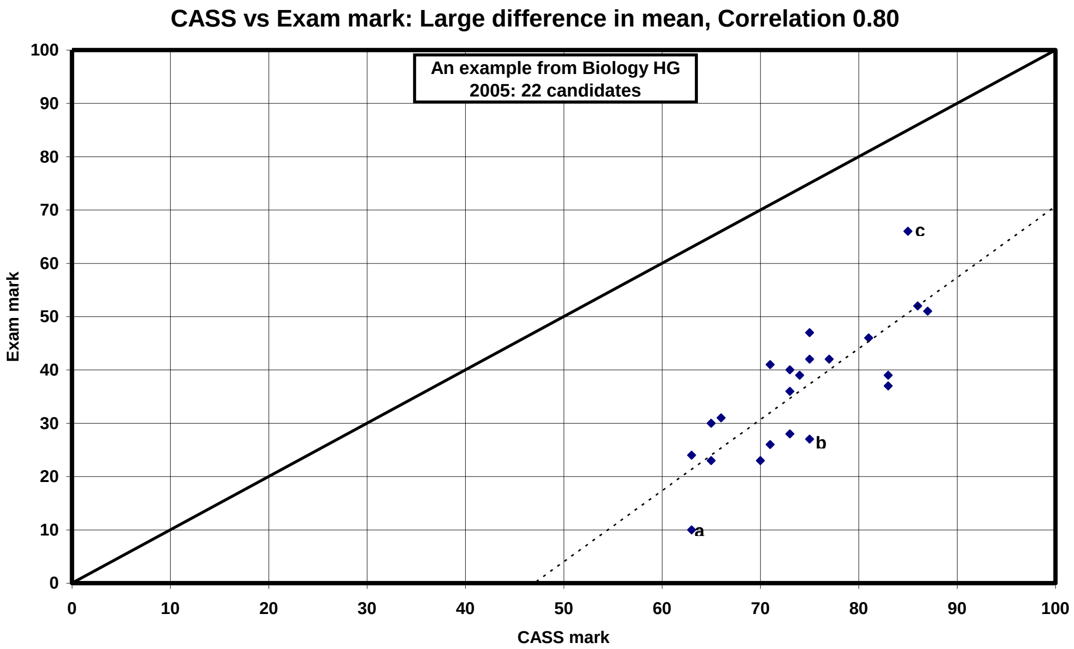
In another school (Figure 3), the mean gap between the CASS and exam marks was negligible (less than 1 percentage points). Yet here the relatively weak correlation coefficient (r=0.46) gave little information to students as to their *relative* performance. Candidate a may perhaps have had an indication that the examination would be a big challenge, as this candidate had a low CASS mark and a relative performance (near the bottom of the class) that accorded with this. Indeed the location to the right of the diagonal showed that this candidate had an even worse examination mark. In contrast, there were some observations in this school to the left of the diagonal, candidates who did better in the exam than in the CASS. Candidate b was in this position, although his/her CASS mark was not all that different from Candidate c's. The examination brought different surprises for them, though: While Candidate b obtained a much higher mark, Candidate c did much worse. Candidate d, meanwhile, rose to the top position and if he/she was better informed, may well have put in enough effort to achieve a distinction (80%): With a CASS mark of 52%, a 75% exam mark must have come as quite a surprise.

Figure 3:



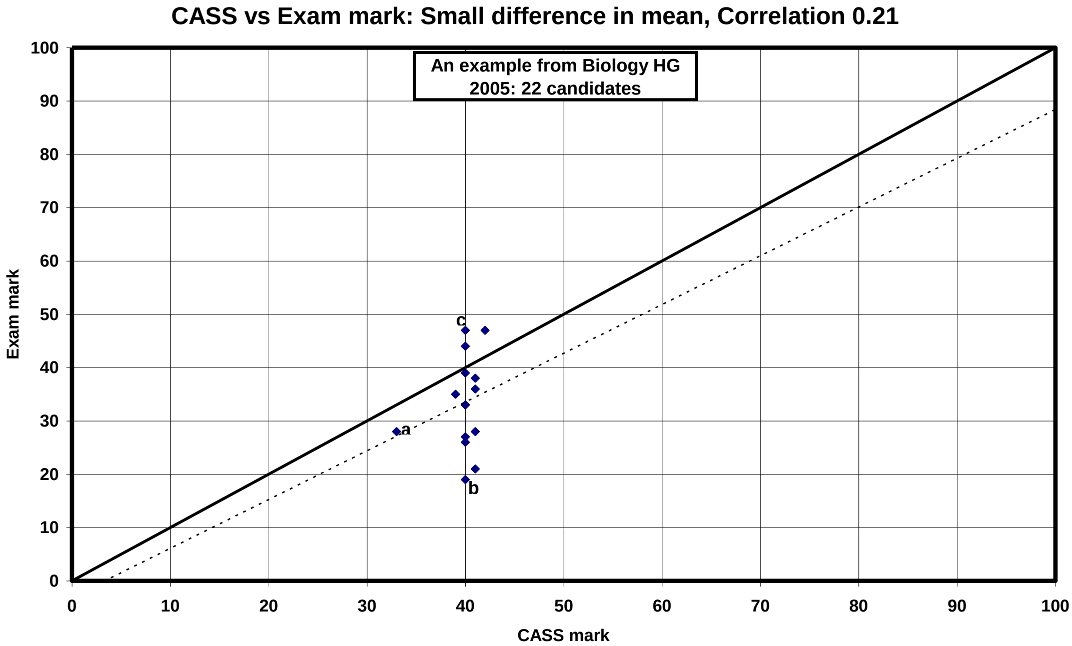
In some cases, relative positions could tell a lot. Suppose that, in the case of the school below (Figure 4), candidates in 2005 had received feedback from results from examination of previous years that indicated that the bottom half of candidates in Biology HG had failed, then Candidate a and Candidate b should have got a clear message that they were in danger of failing, despite their high CASS marks. In contrast, the high mark of Candidate c, though exaggerated (this candidate also lay considerably to the right of the diagonal), should have signalled to the candidate that he/she was quite safe, though it would have given the false impression that a distinction was within reach.

Figure 4:



In contrast to the above, Figure 5 below shows a school with little differentiation between candidates in CASS. In this school, 21 out of the 22 candidates had marks between 39% and 42 % for the CASS. Candidate a, the lone exception with a worse CASS mark of 33%, almost managed to achieve the same mark in the examination. For Candidate b and Candidate c, both with CASS marks of 40%, the exam brought considerably different rewards: 19% and 49%, respectively. Even though the *mean* result was quite similar for CASS and the examination, the CASS mark was largely bare of information to assist these candidates in preparing for the examination. Such a pattern may indicate that the teacher had little confidence in distinguishing between candidates in CASS marks, perhaps due to weak subject knowledge or a poor understanding of the demands of the curriculum.

Figure 5:

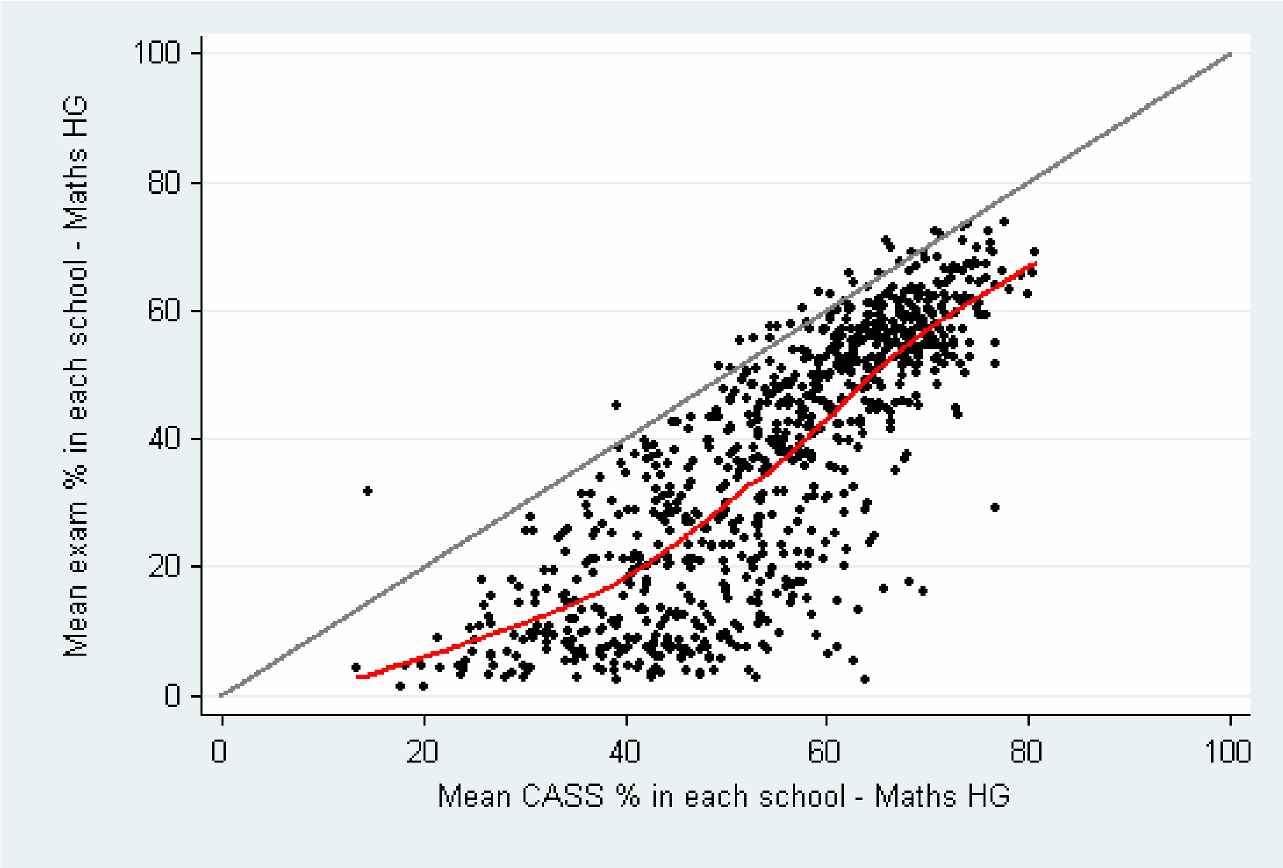


The above examples, all taken from actual situations in Biology HG in 2005, illustrate how important information is, and also that many teachers give weak signals to students. It also shows that both the relative mark (as reflected in a good correlation) and a small gap between the CASS and examination marks are important measures of the quality of information available to candidates on their examination prospects. However, with the large weight now given to CASS marks in the examination, teachers may be playing safe by giving exaggerated CASS mark rather than risking prejudicing the final matric results of their students by giving too low CASS marks.[5]

Figure 6 shows a similar picture to the foregoing figures, but in this case each dot represents a school with more than 15 candidates who entered the Maths HG examination. The majority of schools had CASS marks considerably in excess of their examination marks (i.e. they were located to the right of the diagonal in the figure). The trend line, a lowess (locally weighted regression) curve, indeed also lay considerably to the right of the diagonal. Note, however, that schools in which performance in this subject was better appeared to have less lenient CASS marks compared to the examination marks: The line moved closer to the diagonal.

[5] *Note, however, that where a school's mean CASS mark for a subject exceeds its examination mark by more than 10%, CASS marks are adjusted downwards so as not to exceed this limit.*

Figure 6: School level CASS and exam marks for Maths HG 2005, and lowess (locally weighted) regression trend line



3. Data and methodology

3.1 The data

The total dataset obtained from Umalusi consisted of all data for matric students of South African high schools from the nine provinces for the years 2003, 2004 and 2005. Student level information provided was gender, race and the raw scores (before adjustment) on school continuous assessment and the matric examinations of students for each subject offered by them. At the school level, information regarding the province, quintile and sector (public or independent schools) was available. Due to some inconsistencies in coding which made it difficult to assign individual students to their respective schools for 2003 and 2004, North-West province was excluded from all cross-time analysis. Further coding problems meant that adequate assignment of schools to provinces, quintiles and sectors was only possible for 2005.[6] Students for whom no information was available on either or both sets of marks (assessment and matric examination) were also excluded, and school-level correlations based on fewer than 15 pairs of observations were dropped. The final data set (excluding North-West) consisted of 5162, 5549 and 5547 schools for 2003, 2004 and 2005 respectively, whilst the 2005 data set including North-West consisted of 5968 schools. The mean matric class size per school was 79, 82 and 87 for 2003, 2004 and 2005 respectively.

[6] *Even then, there was conflicting information to in a small number of cases on the quintiles and provinces of some schools.*

3.2. What is an adequate correlation between CASS and examination marks?

The correlation coefficient of two variables measures both the strength and direction of the linear relationship between them.[7] It can take a value ranging between +1 (an increasing linear relationship) and –1 (a decreasing linear relationship). Thus a large and positive correlation between the CASS and exam marks of matriculants in a school could indicate a close positive relationship between the two. Note that correlation in no way implies causation: a linear relationship between X and Y does not mean that X causes Y or vice versa.

"School correlations" between assessment and matric examination marks were calculated for each of seven subjects[8] if there were at least 15 candidates in that school and subject, distinguishing where appropriate also Higher Grade and Standard Grade subjects. Many schools had fewer than 15 candidates in some subjects. A weak or even negative school correlation suggests poor reliability of assessment, in that the school's continuous assessment was poorly matched to the outcomes measured by the matric examination. This would be disquieting if it applied to a considerable number of schools.

Several authors have offered guidelines for interpreting the "strength" of a correlation coefficient. Cohen (1988), for example, suggested the interpretations for correlations in psychological research as shown in Table 1. However, such criteria are somewhat arbitrary, and no single correlation value can be used as identifying a sharp cut-off between accurate and inaccurate assessment. Moreover, for the case considered here, negative correlations would unquestionably indicate extremely weak reliability of assessment.[9]

Table 1: Strength of correlations

Correlation	Negative	Positive
Small	-0.29 to -0.10	0.10 to 0.29
Medium	-0.49 to -0.30	0.30 to 0.49
Large	-1.00 to -0.50	0.50 to 1.00

Source: Cohen (1988)

As no prior published research had been performed in this area (to the knowledge of the authors), the literature offers no guidance as to what correlation value constitutes a strong, positive relationship between the assessment and matric examination marks of a particular school. One way of determining an appropriate correlation threshold is to turn to significance testing. For the minimum number of observations used for comparisons, viz. 15, a correlation of +0.513 is sufficient to state with 99% confidence that there is a significant relationship between the two sets of marks, i.e. there is no more than a 1% probability that this correlation would occur by chance if CASS marks were generated randomly.[10]

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7 *The most popular method to calculate correlations is the Pearson product-moment correlation coefficient $\rho_{x,y}$, calculated by dividing the covariance of the two variables by the product of their standard deviations. An unbiased estimate of $\rho_{x,y}$ can be calculated using the sample correlation coefficient r as follows:*

$$r = \frac{S_{xy}}{\sqrt{(S_{xx}S_{yy})}}$$

8 *These were English (first and second language), Mathematics, History, Biology, Geography and Physical Science (chemistry and physics).*

9 *This is similar to using a poverty line in poverty analysis, in that a correlation threshold, like a poverty line, provides a threshold level by which to determine whether schools are assessing poorly or not. This comparison with poverty analysis will be drawn on in using some of the tools of poverty analysis.*

10 *This follows from the t-value calculated for the correlations, with $t = (r \times n^{½})/[(1-r^2)^{½}]$, with n the sample size and r the correlation. For a one-sided test of significance at $p^2 \geq 0.99$. it turns out that t needs to be 2.650 for n=15 and n-2= 13 degrees of freedom, thus r should exceed 0.513.*

As another alternative to determining an appropriate correlation value to test school assessment accuracy, the calculated correlation coefficients were also used to determine a “synthetic” threshold value, in effect allowing the data to provide its own threshold value that was unique to it (i.e. using the actual distribution of class sizes). The t-statistics and accompanying probability values were calculated for all school correlations. These were subsequently categorised as either significant or insignificant (if the probability that such a correlation would be found by chance was set this time as being below 0.1%). This was then plotted in overlaid bar charts such as that shown for Biology in Figure 7 below to offer a visual means of ascertaining where a threshold value of assessment accuracy may lie. Thus one can determine where “accurate” assessment begins by observing where the “area of insignificance” ends and the “area of significance” begins. These bar charts indicate that the region of “insignificance” ends at a correlation value somewhere between 0.4 and 0.6. The latter value will be used in some of the analysis.

Figure 7:

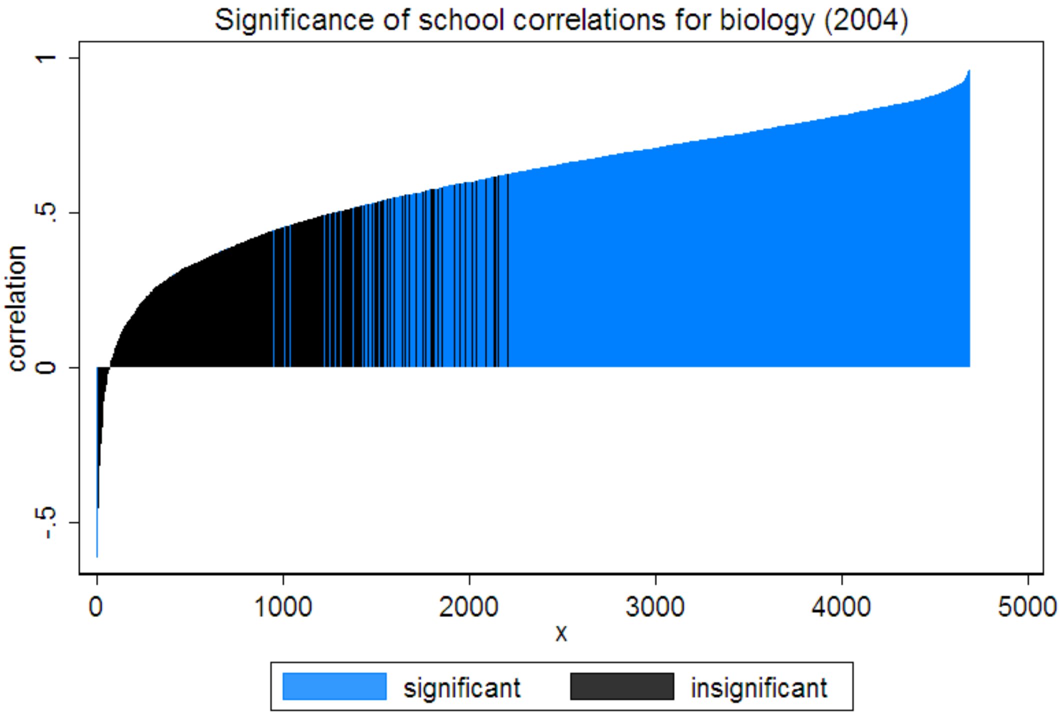


Table 2 offers another clue as to what is an adequate correlation between CASS and examination marks. Some argue that CASS and examination marks need not be closely correlated, as they are intended to test different things. But underlying both continuous assessment and the examination mark is the same latent trait, general cognitive ability, and the same subject curriculum knowledge that should be reflected in the tests. One would thus expect a higher correlation for CASS and exam marks in the same subject than for assessments between unrelated subjects. Table 2 shows pairwise correlations for the same students combining different subjects. Even between such seemingly unrelated subjects as English Second Language and Mathematics SG (two of the subjects most commonly encountered), the correlation was 0.505 in 2005. If such a correlation was found between such unrelated subjects, based only on underlying general ability and motivation of students, one would expect a far higher correlation between the CASS and the examination mark for the same subject, where knowledge of the same curriculum was being tested.

Table 2: Correlation coefficients between individual performance in subjects in examinations, 2005 (number of pupils in parentheses)

	Biology HG	Biology SG	English 1st	English 2nd	Geogr HG	Geogr SG	History HG	History SG	Maths HG	Maths SG
English 1st language	**0.728 (26990)**	0.542 (13270)								
English 2nd language	**0.805 (84001)**	0.620 (190290)								
Geography HG	**0.853 (47608)**	**0.754 (48884)**	**0.745 (17044)**	0.616 (6033)						
Geography SG	**0.745 (8067)**	0.666 (90487)	**0.715 (93156)**	0.580 (95425)						
History HG	**0.830 (11786)**	0.662 (19194)	**0.735 (8620)**	0.494 (3453)	**0.794 (16677)**	0.657 (7504)				
History SG	0.689 (4165)	0.560 (54766)	0.615 (28693)	0.488 (58597)	0.625 (9905)	0.608 (39415)				
Mathematics HG	**0.852 (23963)**	**0.706 (5596)**	0.573 (15206)	0.518 (31906)	**0.768 (11856)**	0.553 (1718)	0.596 (1986)	0.595 (87)		
Mathematics SG	**0.745 (62490)**	0.613 (94204)	**0.728 (28205)**	0.505 (213739)	0.622 (46807)	0.432 (37209)	0.647 (5937)	0.481 (3348)		
Physical Science HG	**0.873 (35928)**	**0.740 (13695)**	0.624 (16890)	0.525 (12271)	**0.766 (19843)**	0.607 (2628)	0.600 (1695)	0.650 (57)	**0.915 (30073)**	**0.813 (31888)**
Physical Science SG	**0.794 (34779)**	0.694 (66899)	**0.730 (45092)**	0.551 (100927)	0.648 (22657)	0.523 (26723)	0.577 (1178)	0.551 (726)	**0.835 (5696)**	**0.785 (110494)**

As indicated, when the scores for the two assessments are totally unrelated to one another, the correlation will be around zero (r=0). In such a case the CASS score would be useless for predicting the examination score – the CASS score for a particular student would give no information about possible performance in the exam. At another extreme, if the CASS score (X) was to be perfectly related to the exam score (Y), by a simple linear equation of the type Y= a + b.X, the correlation coefficient would be one (r=1). Here the same value of a and b would apply for every candidate, and b would be positive. This would imply that once the information is known for the CASS mark (X), the exam mark (Y) would be perfectly predictable and would not provide further insight into the ability of candidate.

In general, when dealing with examination data, having some additional information of a similar type so as to more properly nuance the final allocation of marks, seems appropriate and desirable.

While the correlation coefficient is a measure of the similarity of the paired data values, a related quantity (the square root of $(1-r^2)$) is a measure of the natural variation in scores remaining after using one of the variables to make a best guess rule of the type Y= a + b.X, to estimate the Y-value for a specific X-value. Specifically, the question is what variation one should expect for the examination marks between students who had similar marks for CASS. The specific question is what sort of values of the correlation coefficient might be useful in an education setting. Table 3 presents the levels of correlation coefficient required to attain a specific percentage of the original variance.

Table 3: Shrinkage factors and the correlation coefficients required to obtain such shrinkage relative to a random relationship between CASS and examination marks

Shrinkage factor (standard deviation of Exam mark, given CASS mark)	Shrinkage percentage	R^2 (coefficient of determination)	r (correlation coefficient)
1	100%	0	0
0.9	90%	0.19	0.436
0.8	80%	0.36	0.600
0.7	70%	0.51	0.714
0.6	60%	0.64	0.800
0.5	50%	0.75	0.866
0.4	40%	0.84	0.917
0.3	30%	0.91	0.954
0.2	20%	0.96	0.980
0.1	10%	0.99	0.995
0.0	0%	1.00	1.000

Thus to shrink the variance in the exam mark for a given CASS mark to 50% of its natural spread (where there is no correlation, i.e. the variability is completely random) requires a value of r = 0.866, but to shrink it to 20% of its original extent, the necessary value is r=0.980. As an informal rule of thumb, correlations below 0.75 offer only flimsy evidence of any meaningful relationship.

This can be illustrated by plotting data sets in which the pairs of exam marks and CASS marks pairs have been artificially constructed to have correlation coefficients ranging from 0 to 1. If CASS marks were completely uncorrelated with the examination mark, the situation may have looked as in Figure 8a. The 1000 observations for this figure were generated to reflect a situation where the mean gap between exam and CASS marks is zero, i.e. on average there is no inflation of CASS marks, the mean mark is 50 and the standard deviation 16 for each of the assessment methods, approximating some subject results. A slightly better relationship is observed in Figure 8b, where the coefficient of determination (R-squared) is 0.2, and the correlation 0.447. In this case, the variation in the examination marks for given levels of the CASS mark is reduced to 89.4% of the levels in Figure 8b, i.e. a "shrinkage factor" of 0.894 is applied to the conditional variance in exam marks, given CASS marks. As can be seen, this still reflects only a very small improvement. If the conditional variance is shrunk further, to 77.5% of its original value, the R-squared would improve to 0.4, as in Figure 8c, i.e. 40% of the variance in the exam marks would be explained by the CASS mark. This already requires a correlation coefficient of 0.632, though the figure shows that this still implies much randomness of the examination mark around the CASS mark (i.e. around the diagonal). Further shrinkage of the conditional variance of exam marks to 63.2% of its original value (as in Figure 8d) yields an R-squared of 0.6 and therefore requires a correlation of 0.775, whilst reducing the conditional variance even further to 44.7% of its original value, to obtain an R-squared of 0.8, requires a correlation of 0.894. Even this leaves a fair amount of variation in the examination mark around the CASS mark, and is still a far cry from the perfect match between the assessments that would result if both the R-squared and the correlation coefficient were 1, i.e. where the conditional variance is shrunk to 0% of its original value, and all observations lie on the diagonal.

Figure 8a:

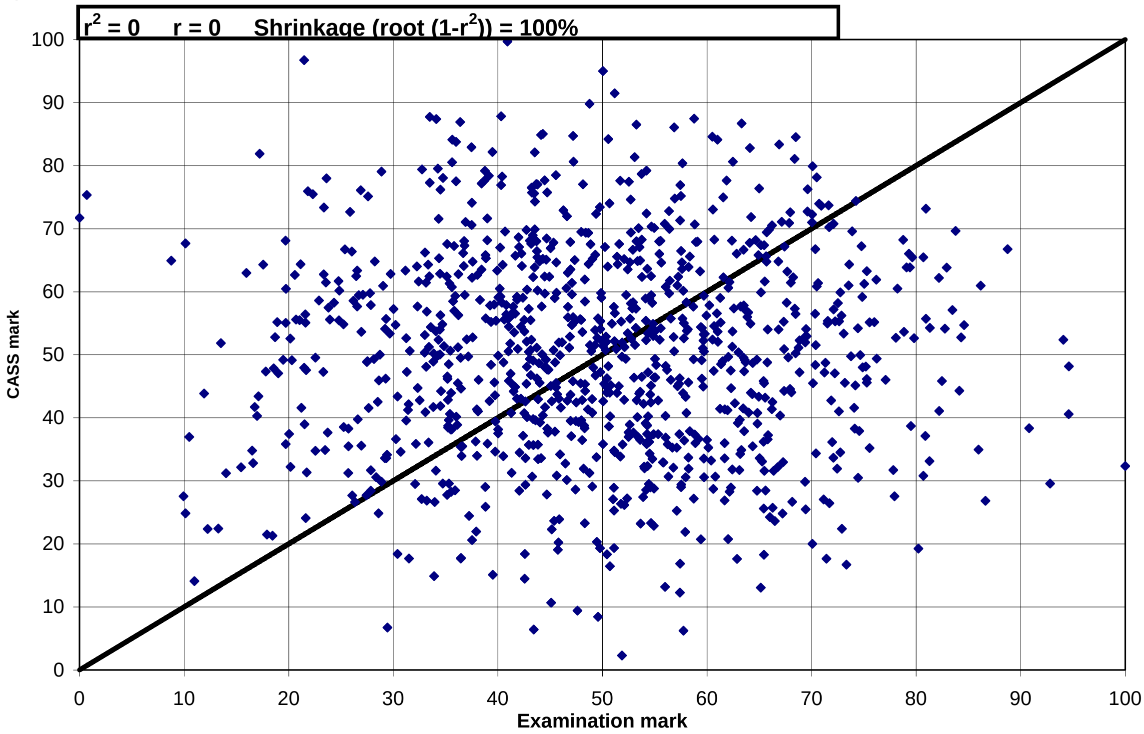


Figure 8b:

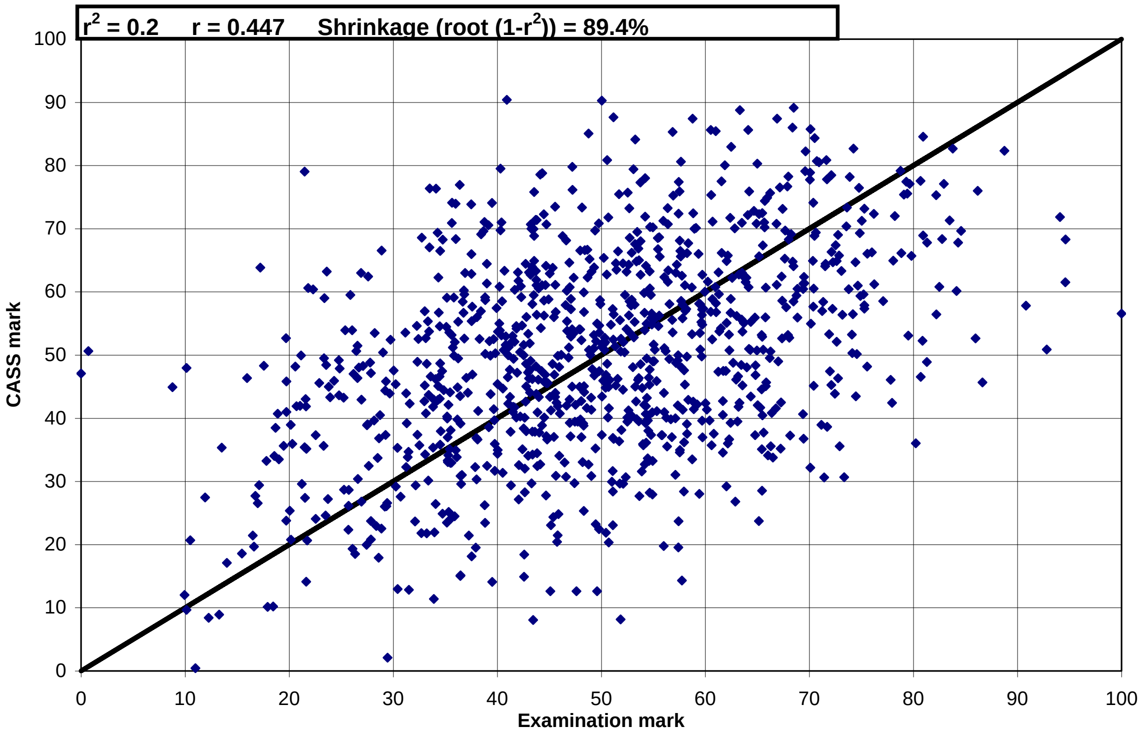


Figure 8c:

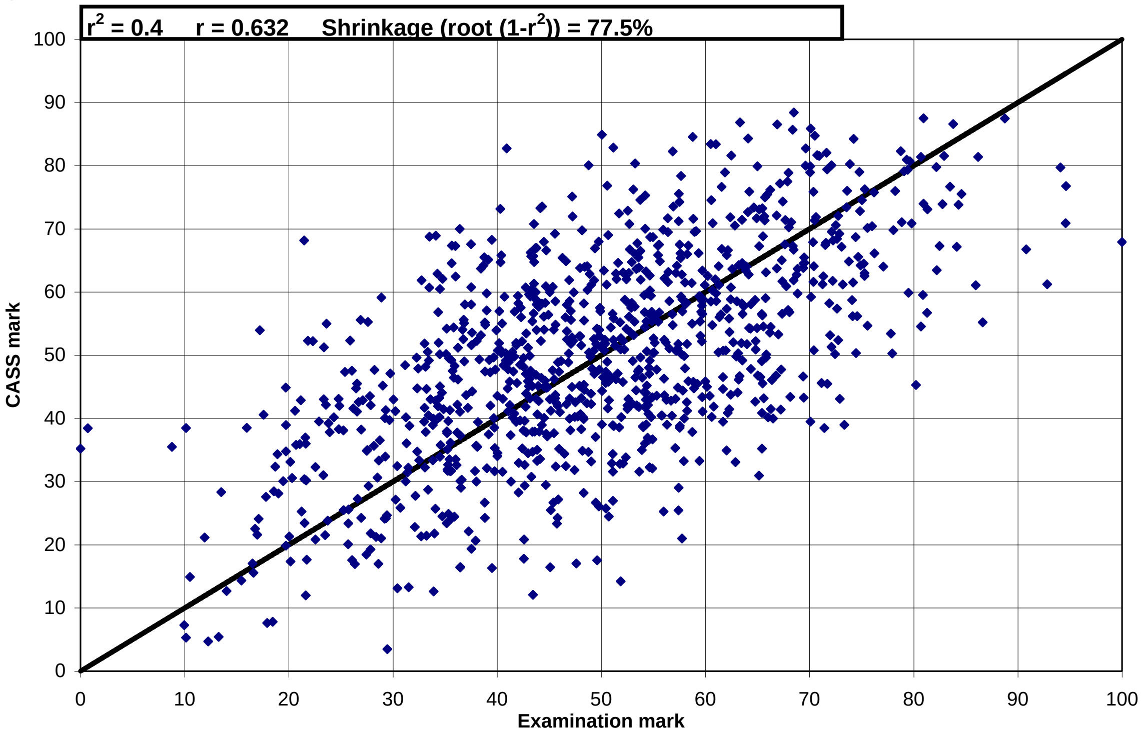


Figure 8d:

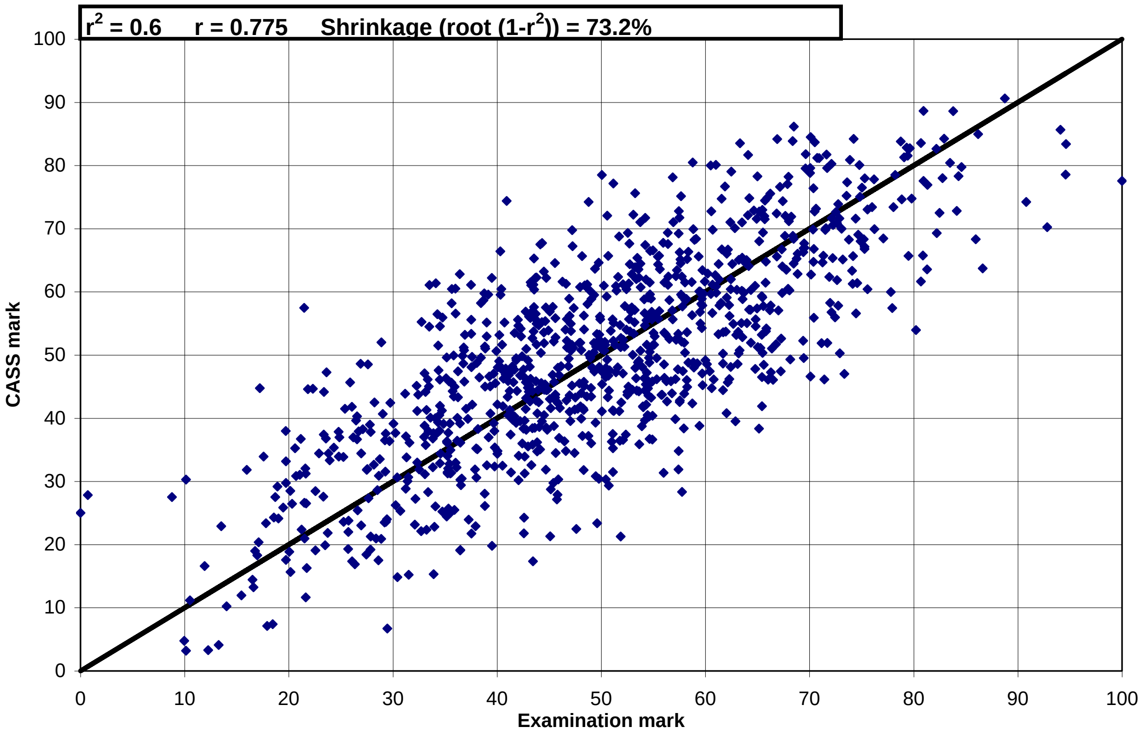
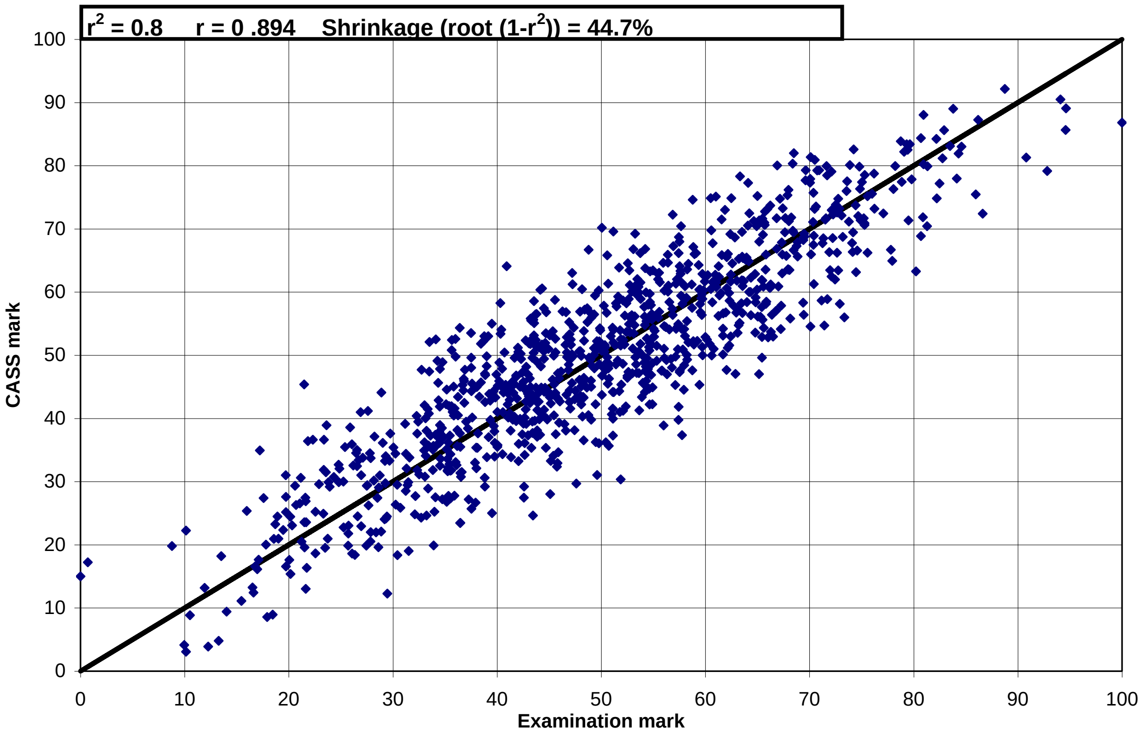


Figure 8e:



It would appear reasonably to consider any shrinkage less than 50% as inadequate. Where the shrinkage factor is 50%, the variance in the examination marks around the CASS marks is still half as large as it would have been if examination marks were purely randomly assigned to candidates with given CASS marks, i.e. the CASS mark still does not provide a very clear signal and contains much “noise” (randomness). But as Table 3 above shows, a relatively high correlation (0.866) is required to achieve this level of shrinkage of the variability in CASS marks.

In the light of the above, using correlation coefficients as low as 0.6 to separate “strong” from “weaker” correlations may thus be too lax a yardstick for assessment accuracy. Far higher correlations should hold in a system that assesses well. As will be shown later (e.g. in Figure 9), in better performing schools and in most subjects, correlations of above 0.8 are quite standard.

4. Individual CASS and examination marks

4.1 Individual CASS and examination marks by subject and province

Table 4 (see Appendix) summarises the means and standard deviations of the assessment and examination marks of all individuals in South African high schools for 2005, by province and subject. (Note that these results include North-West Province.) For each individual student, the actual mark in the examination was compared to the mark obtained for the same subject in the continuous assessment. For every subject and in all provinces, the mean CASS mark was consistently and substantially higher than the examination mark. The fact that the standard deviations of the examination marks were in most cases slightly larger than those of the assessment marks suggested that perhaps many teachers were “playing it safe”, i.e. giving similar marks to high and low performances, a strategy which may be indicative of uncertainty resulting from poor subject knowledge.

A few results are worth mentioning. For English First Language there was a surprisingly small gap between the assessment and examination marks for Kwazulu-Natal of only 1 percentage point, but few students took this subject. Most gaps were larger than 10 percentage points, sometimes even much larger. For example, in Mpumalanga many subject gaps were in excess of 20 percentage points. Considerable gaps were observed for most provinces in Biology and Physical Science, whereas gaps for Geography and English were relatively smaller. No matter what gap threshold magnitude one looked at, larger gaps were more frequent for Biology and Science than for other subjects in 2005.[11]

4.2 Trends at individual level in CASS and examination marks and the assessment gap

One would expect a gradual closing gap between the CASS and examination marks, as teachers adjust their continuous assessments based on feedback from previous exams, to bring it more closely in line with the curriculum standards as indicated by the exam mark. This did not occur. On the contrary, the widening gaps in Table 5 rather provided evidence of worsening examination marks in the majority of cases, with a relatively stable assessment mark. Small reductions of 1 to 2 percentage points in some of the CASS marks were more than made up for by relatively large falls in the examination marks, which may have resulted from examinations being toughened up or from the average quality and preparation of matriculation candidates declining. Worsening examination marks were indicative of an increasing disparity between what was being taught and assessed within the schools, and what was being tested in the examination (in line with the national curriculum). The sharp rise in the mean gap for History HG (from 1.7 to 15.7) and Mathematics HG (8.6 to 18.8) resulted from a very large drop in the examination marks for these subjects. Only for Geography SG did the gap close significantly, and that because of a rise in the examination mark.

Inspection of kernel density distributions[12] of these individual gaps for 2003, 2004 and 2005 showed distribution that were indeed steeper than a normal distribution (i.e. with a higher kurtosis) and with a positive mean, indicating that most students achieved a much higher CASS mark than their matric examination mark. The distributions also appeared to have been shifting rightwards from 2003 to 2005, implying that the divergence between examination and school assessment worsened for the average matriculant.

The standard deviations of the gap were in most cases relatively large. For the more exact subjects one would have expected a smaller gap between the CASS and examination mark, and smaller standard deviations of this gap. However, surprisingly the gap for English (Second Language and especially First Language), traditionally regarded as a "less exact discipline", was smaller and showed even less variance than for a more exact discipline, Mathematics. This may reflect a high level of consensus amongst English teachers about the standards to which they expect students to perform, or that the curriculum was more highly specified, or both.

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[11] *The probability distribution can be represented by a cumulative distribution function (CDF), that can be used to ascertain whether one distribution of correlations first-order stochastically dominates another (Madden & Smith, 2000: 190), or in this case, whether one distribution of correlations is statistically worse than another, irrespective of the criterion value set. If the CDF of Mathematics mark correlations within schools lies below that for Biology for all possible correlation values, then relative assessment reliability in Mathematics between schools is always better than in Biology irrespective of what threshold correlation value has been chosen; that is, the proportion of schools who are assessing their students unreliably will always be smaller in Mathematics than for Biology, irrespective of the criterion threshold chosen. However, if two CDFs intersect, ranking becomes ambiguous and it is unclear whether or not one subject is more reliably assessed than another. The ranking of the assessment accuracy for these two subjects, for instance, will then depend on what criterion one sets for the correlations – technically, first-order dominance then no longer holds (Madden & Smith, 2000: 193). The threshold correlation value is similar to the poverty line employed in poverty analysis, e.g. using the class of poverty measures devised by Foster, Greer and Thorbecke (1984).*

[12] *Kernel density methods are often used to estimate the probability density function of a random variable. The kernel density estimator is sensitive to the choice of bandwidth, as too large a bandwidth can lead to over smoothing (Davidson & MacKinnon, 2004: 679). The kernel densities for different distributions of correlations were compared for years, subjects, provinces and quintiles.*

Table 5: Means and standard deviations of individual assessment and examination marks by subject and grade, 2003-2005 (standard deviations in parentheses)

		CASS Marks			Examination marks			Gap		
		2003	**2004**	**2005**	**2003**	**2004**	**2005**	**2003**	**2004**	**2005**
Biology	**HG**	57.7	57.3	55.9	39.8	35.6	35.1	17.9	21.7	20.8
		(15.9)	(15.3)	(15.2)	(20.7)	(19.0)	(18.3)	(15.5)	(15.2)	(15.3)
Biology	**SG**	45.5	45.8	45.6	30.5	27.2	25.6	15.0	18.5)	20.0
		(13.6)	(13.6)	(13.4)	(13.1)	(13.1)	(12.8)	(13.3)	(14.1)	(14.3)
English 1st language	**HG**	59.0	59.0	58.4	54.0	52.3	52.0	5.0	6.7	6.4
		(12.5)	(12.7)	(12.5)	(14.2)	(14.1)	(14.1)	(9.0)	(8.9)	(8.9)
English 2nd language	**HG**	49.5	49.3	48.9	41.4	36.3	36.2	8.1	13.0	12.7
	HG	(13.3)	(12.9)	(12.9)	(14.3)	(12.6)	(12.8)	(10.5)	(9.9)	(10.2)
Geography	**HG**	46.7	46.2	45.0	36.6	36.4	34.7	10.0	9.8	10.3
	HG	(15.2)	(14.7)	(14.0)	(17.9)	(18.7)	(17.7)	(11.8)	(12.3)	(11.8)
Geography	**SG**	41.6	41.2	41.1	34.8	35.7	36.9	6.8	5.5	4.2
		(12.4)	(12.0)	(11.9)	(14.2)	(13.8)	(14.4)	(12.6)	(12.0)	(12.7)
History	**HG**	50.5	52.3	51.4	48.8	39.6	35.9	1.7	12.7	15.5
		(16.8)	(15.7)	(15.6)	(20.7)	(20.0)	(18.3)	(14.7)	(15.2)	(14.5)
History	**SG**	43.1	43.8	42.8	39.6	35.5	30.9	3.5	8.4	11.9
		(13.1)	(12.8)	(12.8)	(15.9)	(15.4)	(14.4)	(15.4)	(14.6)	(14.0)
Mathematics	**HG**	55.5	56.6	54.5	46.9	42.0	35.9	8.6	14.6	18.6
		(19.9)	(17.5)	(17.8)	(24.6)	(23.5)	(24.3)	(12.4)	(13.8)	(14.5)
Mathematics	**SG**	38.9	40.6	40.1	27.1	27.8	25.8	11.7	12.8	14.4
		(17.7)	(16.1)	(15.9)	(20.5)	(20.2)	(19.7)	(12.6)	(13.2)	(13.5)
Science	**HG**	55.7	54.1	52.8	38.4	33.8	30.8	17.3	20.3	22.0
		(15.2)	(14.9)	(14.7)	(20.1)	(18.6)	(17.6)	(13.0)	(12.1)	(12.2)
Science	**SG**	45.1	44.1	43.8	31.6	29.7	27.6	13.5	14.4	16.2
		(12.8)	(12.4)	(12.0)	(12.8)	(11.6)	(11.5)	(11.8)	(11.2)	(11.3)

The large standard deviations for most other subjects were a cause for concern, pointing to an inconsistent understanding amongst teachers of the level of performance required of students in these subjects. The gap between assessment and examination marks was large throughout the spectrum, but particularly so for those with very high and very low assessment marks. Also interesting is that in almost a quarter of cases where candidates had achieved 50% or above for one of these subjects in CASS, their examination marks lay below 30%.

Umalusi has noted the large gaps between CASS and examination marks and in its moderation imposes a limit of a 10 percentage point deviation between these two: Where the mean CASS mark for a subject in a school deviates by more than 10 marks from the exam mark, all CASS marks are adjusted to reduce the mean gap to 10 marks. Table 6 shows that the share of matriculants who achieved an examination mark of more than 10 percent lower than their school assessment marks (equivalent to a difference of one letter symbol) had increased between 2003 and 2005 for all subjects except Geography. It is also evident that increases were larger at the Higher Grade level. The proportion of History HG students achieving more than 10 percentage points lower in the matric examination than in CASS more than doubled over this short period, from 26.7% to 62.7%, and Mathematics HG too experienced an increase of almost 30 percentage points in this proportion. It is a cause for concern that students were being assessed at lower levels in the school tests and examinations, particularly at the Higher Grade level, as matriculants who took Higher Grade subjects were often academically more ambitious, aiming at matric endorsement (a requirement for university studies). If they were too leniently assessed in school, they were being given false signals of their performance potential in the final matriculation examinations.

Table 6: Share of matriculants with a gap of more than 10 percent, by subject and in aggregate (% of all candidates)

		2003	2004	2005
Biology	**SG**	62.6	71.3	74.2
	HG	64.3	75.6	72.7
English First Language	**All**	24.6	29.9	29.2
English Second Language	**All**	41.4	60.1	58.5
Geography	**SG**	38.1	33.2	31.1
	HG	50.0	48.5	50.1
History	**SG**	32.8	43.8	53.8
	HG	26.7	54.0	62.7
Mathematics	**SG**	53.9	56.1	60.7
	HG	39.8	56.8	68.3
Science	**SG**	59.0	63.8	69.6
	HG	67.6	78.7	82.3
Aggregate	**All**	43.0	57.0	59.9

4.3 Individual level gaps and correlations by subject, 2005

Table 7 again displays the mean gaps, alongside the mean correlations between CASS and examination marks of all individual candidates by subject.[13] The table shows that there were few subjects where there were both high correlations between CASS and examinations marks and a small gap between the two marks. One important exception was English First Language, with a gap of only 6.4 percentage points and a correlation reaching almost 80% (r=0.78). This could perhaps be attributed to the fact that this subject was elected by only a relatively small group of students, mainly concentrated in historically more privileged schools. But English Second Language, taken by many students, often from poor backgrounds, also had both high correlations (0.69) and a small mean gap (12.7 percentage points). It was less surprising that correlations for an exact discipline like Maths were very high in both Higher Grade and Standard Grade – but then, the gaps between the CASS and examination marks were unexpectedly wide. Judged on these data, the worst continuous assessments were those in Biology (particularly SG) and Physical Science SG, although there were also serious problems of assessment in History SG. The picture in Geography SG was mixed, with a weak correlation but a smallish gap.

[13] *In subjects with a large variance in the assessment gaps between different schools, one would expect a lower correlation between individual CASS and exam marks. In such cases, some schools would gain much in their CASS relative to their exam marks, but other schools not, dampening the overall CASS/exam marks relationship.*

Table 7: Mean gap and correlation between CASS and examination marks of individual candidates, 2005

		Mean gap	Correlation
Biology	HG	20.8	0.596
	SG	20.0	0.409
English First Language	HG	6.4	0.782
English Second Language	HG	12.7	0.688
Geography	HG	10.3	0.745
	SG	4.2	0.547
History	HG	15.5	0.643
	SG	11.9	0.477
Mathematics	HG	18.6	0.808
	SG	14.4	0.730
Physical Science	HG	22.0	0.729
	SG	16.2	0.541

5. School level assessment

Thus far, analysis was confined to data at the individual level. To determine how well assessment takes place in individual schools and classrooms, it is necessary to aggregate within schools.[14] Unless specified differently, the analysis from this point onwards is *at the level of the individual school, not weighted by the number of candidates in each school*. Essentially, the intention is to ascertain how accurately teachers assess.[15] [16]

5.1 Gaps at the school level by subject, 2005

Figure 8 shows that the smallest gaps between CASS and examination marks within schools related to Geography SG followed by English First Language, which was also the subject with the highest mean examination mark across schools. Large gaps occurred for some Higher Grade subjects (Science 22, Biology 21, Mathematics 19) and for Biology SG.

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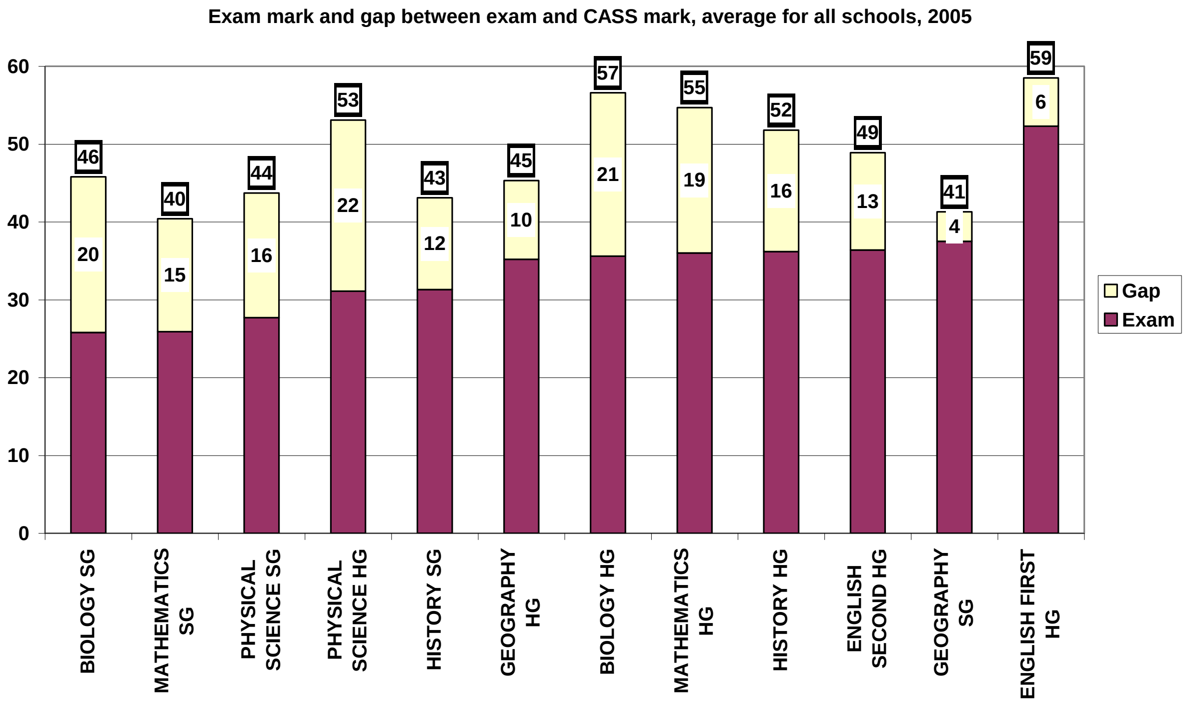
[14] *Strictly speaking, this analysis is at the level of examination centres, which may also contain some private candidates. However, in practice only a small percentage of all candidates are private candidates doing the matric examination..*

[15] *More than one teacher may have been involved in assessment in a school, but assessment across classes within the same school was likely to be relatively consistent compared to assessments across different schools.*

[16] *In order to derive stable data, the analysis is confined to cases where more than 15 candidates from a school entered for examination in that subject.*

Figure 8:



5.2 Intra-school correlations between CASS and exam marks at the school level by subject

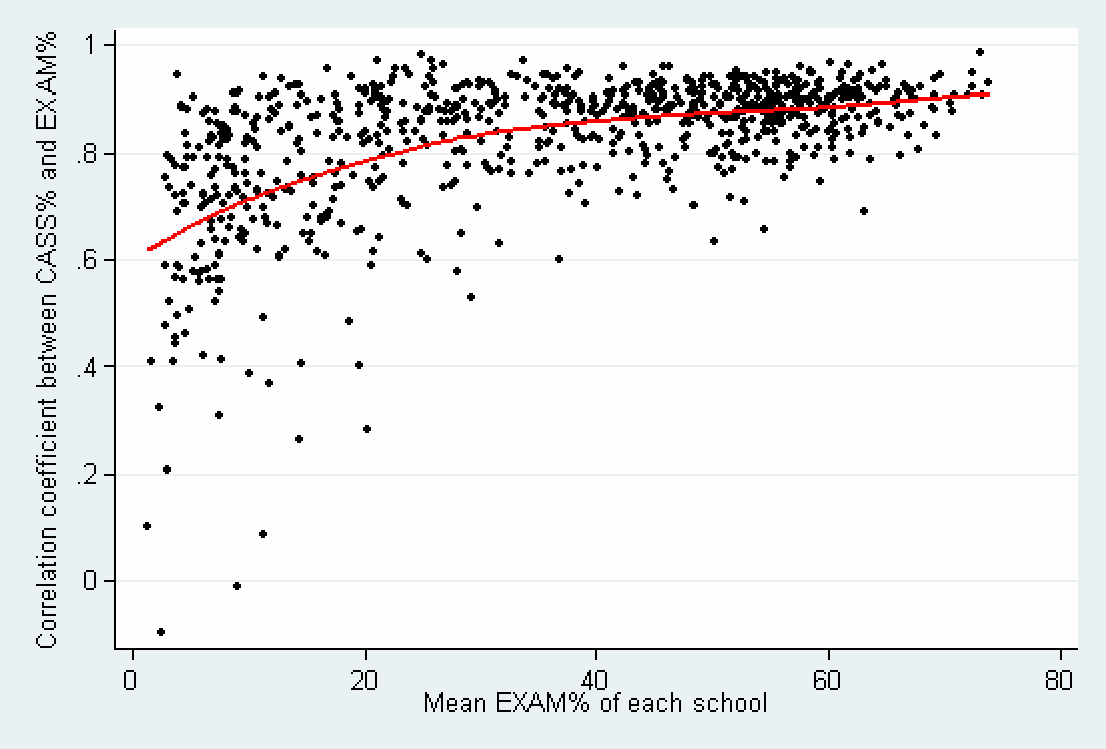
Table 8 shows mean subject correlations for South African schools. Subject correlations in some cases had large standard deviations, perhaps largely due to small numbers of candidates because of subject choice (though schools with fewer than 15 candidates in a subject were not considered in the analysis). There appeared to be stability in the means and standard deviations over the period, with slight improvements in the reliability of assessment within schools of Geography SG and History SG and slight deterioration in that for Biology HG. Mathematics, especially at Higher Grade level, had the highest average correlation within schools (as was the case for all individuals), as well as the smallest standard deviation and thus a larger frequency of more reliable assessment. However, the share of schools where CASS marks showed low reliability also increased, as evident from the increase in the standard deviation of the school correlations for Mathematics. Schools also appeared to assess the two English subjects reliably, with distributions of correlations within schools almost similar to that in Mathematics. History SG was the least reliably assessed subject, with a mean correlation over schools of around 0.5. It would therefore appear that a substantial number of schools do not assess this subject reliably, although there has been some improvement. This combined with the fast widening gap between mean CASS and examination marks for History discussed earlier suggested that assessment accuracy in some schools was deteriorating even further.

Table 8: Means and standard deviations of within-school correlations between CASS and examination mark by subject and grade, 2003-2005

Subject	Grade	Mean correlations			Standard deviation of correlations		
		2003	2004	2005	2003	2004	2005
Biology	HG	0.70	0.68	0.67	0.19	0.20	0.21
	SG	0.59	0.58	0.59	0.19	0.20	0.21
English First Language		0.75	0.74	0.75	0.16	0.16	0.16
English Second Language		0.71	0.69	0.69	0.16	0.17	0.18
Geography	HG	0.70	0.71	0.72	0.16	0.16	0.17
	SG	0.57	0.59	0.61	0.20	0.19	0.20
History	HG	0.64	0.61	0.63	0.20	0.20	0.20
	SG	0.49	0.49	0.53	0.21	0.21	0.20
Mathematics	HG	0.86	0.84	0.83	0.10	0.13	0.13
	SG	0.82	0.80	0.79	0.13	0.14	0.15
Science	HG	0.74	0.76	0.74	0.19	0.17	0.18
	SG	0.64	0.65	0.65	0.19	0.18	0.18

Figure 9 shows a lowess (locally weighted) regression that indicated, for Maths HG, the relationship between a school's mean examination mark and the correlation between the CASS and examination mark for that subject, a measure of assessment reliability. As can be observed, schools performing better in the examination also tended to have more reliable assessment – more specifically, unreliable assessment was only common amongst some schools with low performance in the examination. This figure supports a working hypothesis that unreliability of CASS marks was associated with weak examination preparation.

Figure 9: The relationship between schools' examination marks and the correlation between CASS and examination marks for Maths HG, 2005



5.3 Reliability and leniency of assessment within schools by subject and school quintile or type
Given clear divergences in assessment accuracy of schools by province and by subject, it is interesting to know whether accuracy (both reliability and leniency) also differed by school poverty level and by school type (public versus independent schools). Table 9 shows mean school-level correlations and gaps by subject and grade for 2005 by province, Table 10 by school quintile, and Table 11 by school type. Poor assessment values by either criterion (mean gap above 20, or school level correlation below 0.60) are highlighted in the tables.

There was a major problem in assessment in Mpumalanga, but perhaps more surprisingly, the Northern Cape also showed relatively poor assessment in terms of these two sets of criteria separately. This analysis also confirmed that there were widespread problems in schools in assessing accurately in Biology SG and to an even greater extent with History SG across provinces: The very weak mean correlations encountered here across schools in all provinces, implying poor reliability between CASS and examination marks, raised the suspicion that teacher subject knowledge may have been deficient in schools offering these two subjects, that the curriculum may have been poorly specified or that teachers may not have been setting assessment tasks that could act as good preparation for the examination. Geography HG also bears further investigation.

Table 9: Mean school level correlations and gaps between CASS and examination marks by province, 2005

	West-ern Cape	**Nor-thern Cape**	**Free State**	**East-ern Cape**	**Kwa-zulu-Natal**	**North-west**	**Mpu-ma-langa**	**Gau-teng**	**Lim-popo**	**SA**
Mean school level correlation between CASS and examination marks										
Biology HG	0.75	0.72	0.82	0.76	0.69	0.64	0.56	0.76	0.69	0.67
Biology SG	0.61	0.54	0.73	0.68	0.56	0.52	0.49	0.65	0.59	0.59
English 1st	0.77	0.79	0.76	0.72	0.84	0.77	0.71	0.74	0.76	0.77
English 2nd	0.77	0.80	0.74	0.65	0.66	0.70	0.71	0.73	0.66	0.69
Geography HG	0.54	0.51	0.66	0.63	0.63	0.58	0.59	0.66	0.53	0.61
Geography SG	0.73	0.70	0.80	0.72	0.76	0.72	0.69	0.76	0.67	0.72
History HG	0.73	0.73	0.59	0.61	0.66	0.59	0.56	0.67	0.63	0.63
History SG	0.54	0.50	0.48	0.52	0.54	0.56	0.49	0.52	0.54	0.53
Maths HG	0.86	0.89	0.86	0.85	0.85	0.80	0.76	0.85	0.86	0.83
Maths SG	0.82	0.82	0.85	0.77	0.79	0.77	0.75	0.82	0.81	0.79
Science HG	0.84	0.75	0.84	0.77	0.74	0.69	0.68	0.77	0.75	0.74
Science SG	0.71	0.70	0.70	0.65	0.64	0.60	0.63	0.65	0.63	0.65
Mean gap between CASS and examination marks										
Biology HG	8.0	18.8	10.5	10.6	20.9	18.4	32.6	16.8	17.1	21.3
Biology SG	11.5	25.2	11.5	12.8	23.0	19.3	29.4	19.3	18.1	20.1
English 1st	8.1	4.0	10.4	13.0	2.9	14.2	19.3	6.6	12.0	7.9
English 2nd	7.9	7.3	8.8	12.4	16.6	13.6	15.0	8.0	11.6	13.2
Geography HG	1.8	8.2	3.2	7.8	-0.5	9.7	8.6	-1.6	9.5	3.8
Geography SG	7.7	8.0	5.9	8.3	4.9	11.9	12.9	6.7	20.3	10.1
History HG	10.8	20.5	17.7	13.6	9.2	11.8	22.9	12.7	16.8	15.1
History SG	7.4	14.5	17.0	13.0	8.9	12.7	20.3	11.6	9.7	11.6
Maths HG	12.0	15.0	12.9	12.7	16.8	16.7	29.6	11.6	14.2	18.0
Maths SG	9.4	12.9	7.3	12.1	16.8	12.1	20.9	10.9	11.1	14.4
Science HG	16.6	24.6	14.3	18.3	19.3	22.0	29.3	19.8	18.3	22.4
Science SG	15.1	20.7	10.3	13.8	17.5	17.9	21.7	16.3	13.6	16.1

Highlighted values: Gap = CASS – exam mark > 20 marks, or correlation <0.60

The pattern across quintiles of the school SES distribution (national quintiles) was repeated across almost all subjects: Assessment accuracy differed little by either criterion in the bottom three quintiles for all subjects, but was better by either criterion (reliability and leniency) in the fourth and especially fifth quintiles (Table 10A). Quintile 5 contained more accurately assessing schools. Table 10B in the Appendix shows greater detail, but with marks and gaps shown at individual level, i.e. unlike in Table 10A where each *school* rather than each *individual* carries the same weight.

Table 10A: Mean school level correlations and gaps between CASS and exam marks by school poverty quintile, 2005 (Quintile 1 contains the poorest and Quintile 5 the richest schools)

	Mean school level correlation between CASS and examination marks					Mean Gap between CASS and examination marks				
	Quin-tile 1	Quin-tile 2	Quin-tile 3	Quin-tile 4	Quin-tile 5	Quin-tile 1	Quin-tile 2	Quin-tile 3	Quin-tile 4	Quin-tile 5
Biology HG	0.64	0.61	0.64	0.66	0.74	25.5	25.8	24.5	21.5	14.8
Biology SG	0.61	0.59	0.57	0.58	0.61	21.7	21.8	21.7	19.2	14.6
English First Language	0.74	0.74	0.74	0.75	0.81	11.7	10.7	9.9	7.5	5.6
English Second Language	0.66	0.68	0.69	0.71	0.73	14.5	14.5	14.0	12.6	10.1
Geography HG	0.62	0.62	0.61	0.59	0.61	7.6	4.4	4.0	2.3	0.0
Geography SG	0.71	0.69	0.70	0.71	0.77	12.6	12.7	11.2	9.6	4.9
History HG	0.55	0.57	0.59	0.62	0.72	18.9	19.2	17.3	15.5	8.6
History SG	0.54	0.52	0.52	0.52	0.53	14.3	11.8	11.5	9.7	8.2
Maths HG	0.79	0.78	0.77	0.80	0.86	20.9	26.3	25.2	21.4	14.3
Maths SG	0.78	0.77	0.78	0.78	0.82	17.0	16.3	15.2	13.4	10.3
Science HG	0.67	0.67	0.68	0.71	0.82	26.8	26.8	25.1	22.3	18.4
Science SG	0.64	0.63	0.64	0.64	0.67	17.9	17.8	16.3	14.6	13.7

Highlighted values: Gap = CASS – exam mark > 20 marks, or correlation <0.60

Differences by school type are difficult to interpret given the small number of independent schools and ambiguity in what it means to be an independent school: Both very rich and relatively poor schools are included in this group, explaining the larger standard deviation for independent schools compared to public schools. There were no substantial differences between these two categories, except that the mean gap was usually smaller in independent schools (i.e. CASS marks were less inflated), and for all the Higher Grade subjects (but not English), correlations were considerably better than in public schools.

Table 11: Mean school level correlations and gaps between CASS and examination marks by school type, 2005

	Mean school level correlation between CASS and examination marks		Mean Gap between CASS and examination marks	
	Independent schools	Public schools	Independent schools	Public schools
Biology HG	0.72	0.66	17	22
Biology SG	0.59	0.59	16	20
English First Language	0.74	0.78	18	7
English Second Language	0.69	0.68	12	14
Geography HG	0.56	0.61	2	4
Geography SG	0.73	0.72	9	10
History HG	0.68	0.62	9	15
History SG	0.45	0.53	8	11
Maths HG	0.87	0.82	15	19
Maths SG	0.77	0.79	12	15
Science HG	0.75	0.73	20	23
Science SG	0.64	0.64	16	16

Empirical testing for first-order stochastic dominance in terms of the reliability of CASS revealed the following patterns:

- There was no unequivocal trend over time.
- Western Cape reliability of assessment first-order dominated all eight other provinces. This implied that Western Cape schools were assessing more accurately than schools from other provinces regardless of the threshold chosen for assessment reliability. There was no stochastic dominance between other provinces, thus no further general conclusion can be drawn – the answer depends on the correlation threshold selected.
- Quintile 5 first-order dominated over all the other quintiles over the entire range of correlations, whilst Quintile 4 appeared to dominate the others over most of the relevant range.

Taken across the mean of all subjects (an admittedly weak measure) of the 5968 schools included in the data for 2005, 1107 – almost a fifth – were assessing less reliably, with a correlation coefficient below 0.60. The share of schools within each province with a school correlation of less than 0.60 is displayed in Table 12. Over a quarter of all Kwazulu-Natal and Limpopo schools assessed matriculants unreliably, in comparison to the fewer than 10 percent in the Western Cape and the Free State. The Western Cape, Northern Cape and Free State combined contained only approximately 5 percent of schools assessing unreliably, whereas Mpumalanga and Kwazulu-Natal made up almost two-thirds of such schools in South Africa.

The measure used here is, however, a little problematic, as it does not distinguish between subjects and may thus be affected by factors such as differences in subject weights across schools. An alternative is to investigate provincial differentials in some individual subjects. English Second Language and Mathematics SG, the most assessed subjects, were investigated and the results are presented in Table 13. Again, in terms of reliability of assessment in English Second Language, Limpopo and Kwazulu-Natal schools fared the worst. Although the Northern Cape had a reasonable share of schools faring poorly in terms of overall assessment reliability, a mere 4 percent were assessing unreliably in English Second Language. Once again, two provinces were responsible for a substantial share of poor assessment reliability. Kwazulu-Natal and Mpumalanga accounted for more than 50 percent of the unreliably assessing schools in English Second Language. In the case of Mathematics SG, the picture was similar, in that Kwazulu-Natal and Mpumalanga again accounted for more than half of the unreliably assessment schools (though unreliably assessment was less common in this subject), with the Eastern Cape also comprising a substantial share at 18 percent.

Returning to Table 12, over a fifth of the schools in each of the bottom three quintiles under-performed in terms of student assessment reliability, much more than in the top two quintiles. Of all schools assessing unreliably, more than 80 percent came from the bottom three quintiles.

Table 12: Share of schools with correlation between all CASS and examination marks across all the selected subjects below a threshold of 0.6, by province and Quintile, 2005

Province	Share of schools assessing inaccurately (%) within province	Provincial share in sample of schools assessing inaccurately
Western Cape	6.0	1.9
Northern Cape	15.1	1.4
Free State	7.4	2.0
Eastern Cape	12.6	10.0
Kwazulu-Natal	28.2	38.2
North-West	16.9	6.4
Mpumalanga	17.8	21.8
Gauteng	15.0	8.4
Limpopo	27.3	9.8
South Africa	18.5	100.0
Quintile 1 (poorest)	23.3	31.3
Quintile 2	24.7	25.3
Quintile 3	20.1	24.8
Quintile 4	12.9	11.1
Quintile 5 (richest)	8.9	7.5
South Africa	18.9	100.0

Note: Discrepancies in the share for South Africa result from the fact that some schools were not ordered by quintiles.

Table 13: Share of schools with correlation below threshold of 0.6 for English Second Language and Mathematics SG, by province (2005)

	English Second Language		Mathematics SG	
Province	**% of schools assessing poorly**	**Provincial share of poorly assessing schools**	**% of schools assessing poorly**	**Provincial share of poorly assessing schools**
Western Cape	9.0	2.2%	3.1	2.3%
Northern Cape	3.8	0.3%	5.1	0.7%
Free State	15.0	3.7%	3.6	1.8%
Eastern Cape	18.5	13.0%	10.3	17.8%
Kwazulu-Natal	30.6	34.3%	8.9	27.7%
North-West	23.3	7.8%	11.5	9.5%
Mpumalanga	19.7	22.6%	14.7	28.4%
Gauteng	17.6	6.3%	5.8	7.4%
Limpopo	30.3	9.7%	5.7	4.4%
Total		100.0%		100.0%

5.4 Assessment quality at the school level: considering both reliability and leniency

A fuller reflection of the quality of assessment should consider *both* the gap between mean CASS and examination marks and the correlation between these two. In Table 14, criteria for "accurate" versus "extremely inaccurate" assessment standards in a school were set as follows:

- If the difference between the mean assessment mark and mean examination marks in a school was less than 10 percentage points *and* the correlation between these two sets of marks is 0.60 or more, a school was taken to be assessing accurately.
- If the difference between the mean assessment mark and mean examination marks in a school was greater than 20 *and* the correlation between these two sets of marks was 0.40 or less, a school was taken to be assessing extremely inaccurately.

By the criteria used here, there was a surprisingly high frequency of schools assessing accurately. Good assessments by these criteria were especially found in History HG (65% good assessment) and English Fist Language (61%), followed by Geography (HG & SG) and History SG. Schools assessing very accurately were uncommon in Physical Science (both HG and SG) and Biology (especially SG).

In contrast, extremely inaccurate assessment was less common, judged by these rather low threshold criteria (exam marks more than 20 percentage points below assessment marks, and the correlation between the two marks less than 0.4). Biology (SG 19%, HG 16%), and Science HG (11%) stood out as the subjects where weak assessment occurred relatively frequently.

Table 14: Proportion of schools assessing accurately (correlation>=0.60, mean gap <=10) and inaccurately (correlation<0.40, mean gap>20) using combined criteria

	Accurate assessments	**Extremely inaccurate assessments**
Biology HG	20%	16%
Biology SG	15%	19%
English First Language HG	61%	0%
English Second Language HG	28%	3%
Geography HG	47%	1%
Geography SG	44%	2%
History HG	65%	0%
History SG	40%	0%
Mathematics HG	30%	2%
Mathematics SG	34%	2%
Physical Science HG	9%	11%
Physical Science SG	13%	6%

However, the assessment performance using a single criterion rather than these combined criteria appeared to be far less satisfactory. This related especially to the mean assessment marks, which was extraordinary high in some schools, even where assessment marks did correlate with exam marks. For example, for Biology SG, more than 200 schools out of 5300 had assessment marks more than 40 percentage points above the examination mark. Yet even in these schools, more than a third had a correlation of 0.60 or higher between these two marks. Similar figures applied to other subjects. So it appeared that the tendency to give high assessment marks was not necessarily always closely related to poor correlation with the examination mark. It appeared as if teachers could rank student performance relatively well, but gave extremely lenient high marks. This may have been related to a culture of setting marks too high in earlier grades in order to reduce failures or deflect parent protests.

Table 15: Share of schools with correlation below threshold of 0.60 by subject and grade, 2005

		% of schools assessing subject unreliably	Number of schools assessing sub-ject unreliably	Subject share of schools assessing unreliably
Biology	**HG**	0.30	2 362	8%
	SG	0.45	4 358	14%
English First Language	**HG**	0.13	961	3%
English Second Language	**SG**	0.22	5 330	18%
Geography	**HG**	0.18	2 375	8%
	SG	0.40	2 517	8%
History	**HG**	0.35	843	3%
	SG	0.60	1 794	6%
Mathematics	**HG**	0.06	820	3%
	SG	0.09	4 774	16%
Physical Science	**HG**	0.17	1 339	4%
	SG	0.34	2 969	10%
Total for these subjects			30 442	100%

Note: "Unreliable" assessment is here taken to be a CASS mark correlated below 0.60 with the exam mark in that subject, for subjects entered by at least 15 candidates in a school.

6. Conclusion

Assessment provide important signals to students that should assist them to prepare for examinations and make informed choices about career options, further studies and subject choice, both at school and beyond. Analysis showed that schools where there was less reliable continuous assessment tended to perform worse in examinations.

Two measures of accuracy of continuous assessment were used and applied across a number of subjects: The leniency with which CASS marks were awarded (compared to examination marks), measured as the gap between these marks, and the reliability of CASS marks in terms of their correlation with examination marks.

The analysis was conducted at two levels. First, all individual marks in different subjects were analysed using the above two measures of assessment accuracy, and patterns were investigated. Secondly, a similar analysis was conducted at school level rather than of individual marks, to determine in which schools assessment was less accurate, and to attempt to identify patterns in this regard.

The broad conclusions of this study are that continuous assessment accuracy was weakest in terms of the great leniency of assessment in many schools (inflated CASS marks), although unreliability of assessment also was a cause for concern in some cases. This requires targeted interventions. There was also evidence of a clear hierarchy in terms of assessment accuracy. The bulk of inaccurately assessing schools by both measures combined were in Mpumalanga and Kwazulu-Natal, with the Eastern Cape also a large contributor. The Western Cape and schools in the top and even the second quintiles of the SES distribution assessed much better. In terms of subjects, Mathematics (both HG and SG) was the best assessed subject, with English First and Second Language falling close behind. This contrasted to History, where there was a larger share of poorly assessing schools than for any other subject.

Added to this was the disturbing finding that these gaps had in most cases been increasing, in some cases substantially so. Kwazulu-Natal and Mpumalanga witnessed large increases in their aggregate gaps, whilst the small gap in History had increased four-fold. The gaps were widening largely as a result of falling examination marks, in part the results of tightening up of the national examinations, but perhaps also because of a larger number of under-prepared students entering the examinations.

Apart from the fact that weak continuous assessment in matric, and presumably also assessment in earlier grades, is sending wrong signals to students and parents, resulting in inappropriate subject choices, career planning and examination preparation, there is a further issue that the authorities should take note of. With the 25% weighting given to CASS marks in matriculation and the limit of a mean deviation of 10% either way between examination and CASS marks that Umalusi imposes, differences in strategic behaviour between teachers or schools can have important consequences. Schools setting high standards in CASS in order to induce more intensive learning in preparation for the examination may place their candidates at a considerable disadvantage (of up to 5 percentage points) in the final matric mark relative to schools who persist with lenient assessment.

There is a wider consideration also, though. It is extremely worrying that differentials between CASS and exam marks do not result in feedback and improved assessment the following year. Teachers do not appear to be seriously re-evaluating their own assessment standards on the basis of the exam marks, thus the link between CASS and curriculum standards remains weak. This information is not systematically used nor even made available by the education authorities, thus no corrective feedback occurs. Information about weak signalling by teachers can, ironically, also serve as feedback to teachers to improve their assessment practices. Moreover, this paper provides ample evidence that the information for such improved signalling to teachers exists within the education system; it simply needs to be used by policy makers.

Bibliography

Cohen, J. (1988). *Statistical power analysis for the Behavioral Sciences* (2nd ed.) Hillsdale, NJ: Lawrence Erlbaum Associates.

Davidson, R. and J.G. MacKinnon. (2004). *Econometric theory and methods*. Oxford University Press: Oxford.

Burger, Don (no date). Using standards-led policy to align assessment and accountability systems. *Pacific Resources for Education and Learning*. Accessed 12th Feb. 2008 at: http://www.prel.org/products/re_/standards-led.htm

Madden, D. and F. Smith. (2000). Poverty in Ireland, 1987-1994: A Stochastic Dominance Approach. *Economic and Social Review* 31(3): 187-214

Moskal, Barbara M. & Jon A. Leydens. (2000). Scoring rubric development: validity and reliability. *Practical Assessment, Research & Evaluation* 7(10). Retrieved February 11, 2008 from http://PAREonline.net/getvn.asp?v=7&n=10.

Moskal, Barbara M, Jon A. Leydens and Michael J. Pavelich (2002). Validity, reliability and the assessment of engineering education. *Journal of Engineering Education*, July. Accessed 12th Feb. 2008 at: http://findarticles.com/p/articles/mi_qa3886/is_200207/ai_n9121811/pg_1

Nicol, D. and D. Macfarlane-Dick. (2006). Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education* 31(2).

North Central Regional Technology in Education Consortium (2002). *Glossary of Education Terms and Acronyms.* Accessed 12th Feb. 2008 at: http://www.ncrel.org/sdrs/areas/misc/glossary.htm

Pearson Education (no date). Assessment: Reliability/Validity. Accessed 12th Feb. 2008 at: http://www.ecs.org/html/issue.asp?issueid=12&subIssueID=123

Van der Berg, Servaas & Shepherd, Debra. (2009). *Signalling performance: an analysis of continuous assessment and matriculation examination marks in South African schools.* Umalusi: Pretoria. 40pp.

Appendix: Table 4: Mean CASS marks, examination marks and gaps for all candidates, selected subjects (standard deviation in parentheses)

	Western Cape		Northern Cape		Free State		Eastern Cape		Kwazulu-Natal		North West		Mpuma-langa		Gauteng		Limpopo		South Africa (North West included)	
	Mean	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**
	Biology HG																			
CASS	60.4	(15.0)	65.7	(14.6)	53.3	(15.0)	47.2	(15.9)	56.9	(14.7)	47.9	(15.2)	57.1	(13.8)	60.7	(14.2)	52.5	(15.2)	55.9	(15.2)
Exam	52.7	(16.6)	46.4	(15.4)	43.3	(17.3)	36.7	(17.2)	36.8	(17.3)	29.1	(15.9)	24.0	(13.0)	44.7	(17.7)	36.8	(16.8)	35.1	(18.3)
Gap	7.7	(10.3)	19.3	(11.0)	10.1	(9.1)	10.5	(9.8)	20.2	(13.5)	18.8	(12.2)	33.1	(14.4)	15.9	(11.3)	15.7	(11.7)	20.8	(15.3)
	Biology SG																			
CASS	42.9	(12.5)	54.6	(13.3)	39.9	(11.3)	39.3	(11.4)	48.6	(12.9)	43.3	(13.4)	52.2	(13.7)	48.0	(12.1)	41.2	(12.1)	45.6	(13.4)
Exam	31.5	(13.7)	28.9	(12.8)	28.3	(13.3)	26.0	(12.2)	25.5	(12.6)	23.1	(12.7)	22.0	(11.6)	27.6	(13.6)	22.8	(11.8)	25.6	(12.8)
Gap	11.5	(11.1)	25.6	(13.5)	11.6	(10.4)	13.3	(10.6)	23.0	(14.5)	20.2	(13.8)	30.2	(15.0)	20.4	(12.6)	18.4	(11.9)	20.0	(14.3)
	English First Language HG																			
CASS	57.2	(12.9)	53.6	(12.9)	55.8	(11.5)	56.2	(12.8)	59.8	(12.3)	56.6	(13.4)	56.5	(11.9)	59.5	(12.1)	59.0	(13.0)	58.4	(12.5)
Exam	49.8	(13.7)	50.8	(12.4)	45.5	(12.6)	43.7	(13.1)	57.2	(13.1)	43.3	(12.6)	39.8	(11.4)	54.3	(13.3)	48.1	(13.9)	52.0	(14.1)
Gap	7.4	(8.6)	2.8	(8.4)	10.3	(8.6)	12.4	(7.8)	2.6	(7.0)	13.3	(8.1)	16.8	(12.0)	5.2	(8.5)	10.9	(8.7)	6.4	(8.9)
	English Second Language HG																			
CASS	51.3	(13.1)	50.9	(11.7)	46.7	(12.7)	43.8	(12.2)	50.2	(12.9)	48.7	(12.8)	49.3	(12.2)	52.8	(13.1)	48.1	(12.6)	48.9	(12.9)
Exam	43.1	(13.6)	43.0	(12.9)	37.9	(13.5)	32.6	(11.4)	33.8	(11.6)	34.9	(12.3)	34.4	(10.7)	44.7	(14.8)	36.3	(12.4)	36.2	(12.8)
Gap	8.1	(8.5)	7.8	(8.5)	8.7	(8.8)	11.2	(9.4)	16.4	(10.5)	13.8	(9.7)	14.9	(10.0)	8.1	(9.2)	11.8	(9.4)	12.7	(10.2)
	Geography HG																			
CASS	60.7	(13.9)	52.9	(15.4)	47.4	(14.2)	45.1	(15.1)	49.3	(14.8)	41.7	(12.2)	40.1	(10.7)	51.0	(15.0)	44.4	(12.2)	45.0	(14.0)
Exam	54.0	(15.9)	45.4	(16.0)	40.0	(15.3)	36.4	(16.2)	45.0	(19.9)	29.6	(14.5)	27.0	(11.3)	44.0	(18.3)	24.0	(11.8)	34.7	(17.7)
Gap	6.6	(10.9)	7.5	(10.4)	7.3	(10.0)	8.7	(10.7)	4.3	(14.2)	12.1	(10.0)	13.1	(9.2)	7.0	(12.2)	20.3	(8.9)	10.3	(11.8)
	Geography SG																			
CASS	46.2	(12.7)	41.6	(13.0)	38.3	(10.4)	37.8	(11.4)	44.1	(11.9)	38.6	(10.7)	37.8	(10.4)	38.9	(12.2)	42.9	(9.7)	41.1	(11.9)
Exam	44.8	(13.2)	32.7	(12.6)	34.8	(11.0)	29.4	(10.9)	44.6	(14.9)	28.3	(11.9)	28.7	(9.7)	40.1	(14.6)	32.9	(10.0)	36.9	(14.4)
Gap	1.4	(11.7)	8.9	(12.1)	3.6	(9.7)	8.4	(10.6)	-0.5	(14.2)	10.4	(10.3)	9.1	(9.7)	-1.1	(12.2)	10.0	(9.8)	4.2	(12.7)

(**Continued on next page)**

Table 4 (Continued)

	Western Cape		Northern Cape		Free State		Eastern Cape		Kwazulu-Natal		North West		Mpuma-langa		Gauteng		Limpopo		South Africa (North West included)	
	Mean	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**	**Mean**	**Std Dev.**
History HG																				
CASS	62.0	(15.7)	56.5	(12.7)	55.4	(14.4)	51.1	(17.2)	50.2	(15.9)	41.8	(15.2)	49.1	(12.9)	57.3	(14.5)	44.3	(16.0)	51.4	(15.6)
Exam	50.7	(16.3)	34.4	(12.4)	38.2	(13.1)	36.4	(18.4)	40.9	(18.3)	29.0	(17.5)	25.5	(12.8)	44.4	(18.0)	28.5	(16.4)	35.9	(18.3)
Gap	11.3	(11.2)	22.0	(10.3)	17.2	(14.4)	14.7	(12.5)	9.3	(13.9)	12.7	(13.3)	23.6	(13.3)	12.9	(13.6)	15.8	(12.5)	15.5	(14.5)
History SG																				
CASS	47.1	(13.2)	47.4	(12.9)	45.9	(11.0)	40.5	(12.2)	43.8	(12.8)	36.2	(12.6)	44.2	(12.7)	43.9	(11.9)	37.2	(11.6)	42.8	(12.8)
Exam	39.3	(13.9)	33.6	(12.5)	27.9	(12.2)	26.8	(13.0)	34.5	(14.6)	22.8	(13.0)	23.0	(12.5)	32.0	(14.2)	27.7	(11.8)	30.9	(14.4)
Gap	7.8	(12.7)	13.8	(12.3)	18.0	(13.5)	13.7	(13.6)	9.2	(14.3)	13.4	(13.5)	21.2	(13.9)	11.9	(13.8)	9.5	(12.3)	11.9	(14.0)
Mathematics HG																				
CASS	64.1	(17.0)	61.0	(14.5)	61.7	(17.4)	56.2	(17.9)	53.7	(17.9)	50.9	(18.0)	47.4	(16.0)	57.2	(16.6)	57.1	(17.0)	54.5	(17.8)
Exam	52.4	(20.6)	45.1	(18.4)	47.8	(19.2)	40.7	(22.9)	36.4	(23.8)	34.1	(22.4)	16.7	(17.9)	45.2	(21.3)	41.5	(20.3)	35.9	(24.3)
Gap	11.8	(10.5)	15.8	(11.6)	13.9	(10.4)	15.4	(12.8)	17.3	(12.9)	16.8	(12.9)	30.7	(13.3)	12.0	(12.1)	15.6	(11.1)	18.6	(14.5)
Mathematics SG																				
CASS	44.8	(18.2)	45.0	(16.4)	41.4	(17.5)	37.7	(15.0)	40.1	(15.4)	36.8	(15.1)	42.7	(14.9)	41.6	(16.2)	35.2	(15.3)	40.1	(15.9)
Exam	36.0	(21.3)	31.6	(19.8)	33.9	(20.7)	24.9	(17.8)	23.2	(18.4)	23.7	(19.4)	21.7	(18.6)	29.9	(21.2)	23.7	(19.0)	25.8	(19.7)
Gap	8.8	(11.2)	13.5	(11.9)	7.5	(11.3)	12.9	(12.3)	16.9	(13.5)	13.1	(13.3)	21.0	(14.5)	11.7	(13.2)	11.5	(11.5)	14.4	(13.5)
Physical Science SG																				
CASS	48.0	(12.4)	52.5	(12.1)	40.2	(11.3)	41.1	(11.2)	44.2	(12.5)	44.8	(12.2)	47.0	(11.8)	45.2	(11.1)	40.2	(11.3)	43.8	(12.0)
Exam	32.5	(13.2)	32.1	(12.8)	30.1	(11.8)	26.8	(10.9)	26.6	(11.1)	26.0	(11.2)	25.5	(10.3)	28.7	(11.8)	27.1	(10.8)	27.6	(11.5)
Gap	15.5	(9.6)	20.4	(10.7)	10.1	(8.3)	14.3	(9.9)	17.6	(12.4)	18.8	(11.6)	21.4	(12.3)	16.5	(10.7)	13.1	(10.0)	16.2	(11.3)
Physical Science HG																				
CASS	63.8	(14.3)	61.9	(13.1)	50.0	(16.0)	54.2	(16.1)	49.0	(15.3)	48.6	(15.0)	50.8	(11.6)	58.1	(13.9)	51.4	(15.3)	52.8	(14.7)
Exam	47.2	(18.4)	39.4	(17.0)	35.9	(17.0)	35.5	(18.0)	30.2	(17.5)	27.2	(15.3)	21.4	(11.2)	38.3	(17.9)	33.6	(16.3)	30.8	(17.6)
Gap	16.6	(10.1)	22.5	(11.6)	14.1	(7.8)	18.7	(10.3)	18.9	(13.0)	21.5	(11.3)	29.4	(10.5)	19.8	(11.2)	17.9	(9.8)	22.0	(12.2)

Note: Mean gaps exceeding 20 percentage points are highlighted

Appendix: Table 10B: Individual CASS marks, exam marks and gaps, and correlations by school between CASS and exam marks by national school quintile

	Mean CASS marks					Mean Exam marks					Mean Gaps					Correlation: CASS vs. Exam	
	Quintile					Quintile					Quintile					Quintile	
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	5
Biology HG	53.8	52.0	52.5	54.5	61.0	29.2	26.4	28.0	32.6	47.0	24.6	25.5	24.5	21.9	14.0	0.500	0.697
Biology SG	45.1	45.2	45.1	45.9	45.8	23.7	23.7	23.8	26.4	30.9	21.4	21.5	21.3	19.5	14.9	0.398	0.508
English First Language	58.4	52.8	54.4	56.1	59.4	47.1	42.2	45.3	49.9	54.8	11.3	10.6	9.1	6.2	4.6	0.816	0.800
English Second Language	46.7	47.2	48.1	49.4	51.5	33.0	33.2	34.8	36.8	41.2	13.7	14.0	13.3	12.6	10.3	0.606	0.767
Geography HG	42.1	41.7	41.7	43.1	52.4	29.4	29.1	30.4	32.8	46.8	12.7	12.6	11.4	10.3	5.6	0.663	0.799
Geography SG	40.6	39.4	40.1	41.9	44.1	32.9	35.0	35.7	39.3	43.2	7.8	4.4	4.5	2.6	0.8	0.502	0.611
History HG	50.3	48.3	46.1	49.1	58.2	31.1	30.0	29.5	32.5	48.7	19.2	18.3	16.7	16.7	9.4	0.569	0.738
History SG	42.6	41.6	41.5	43.3	46.0	28.2	29.0	29.8	33.0	37.2	14.5	12.6	11.7	10.3	8.8	0.420	0.559
Mathematics HG	50.5	47.2	47.0	49.8	60.1	28.5	21.2	22.7	28.9	45.6	22.0	26.0	24.3	20.9	14.4	0.781	0.831
Mathematics SG	39.4	38.2	37.0	38.7	45.2	22.3	21.7	21.8	24.9	34.6	17.0	16.5	15.1	13.8	10.6	0.693	0.795
Physical Science HG	50.6	48.7	47.5	48.7	57.4	25.1	22.2	23.3	26.9	39.3	25.5	26.5	24.2	21.7	18.1	0.645	0.803
Physical Science SG	43.8	43.6	42.6	42.5	45.6	25.9	25.5	26.1	27.9	31.7	18.0	18.2	16.5	14.6	13.9	0.501	0.642

Note: Quintile information was only available for 5044 out of 6174 exam centres (schools).